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Effect of use aggregation pheromone to reducing the amount of pesticides that needed to control American cockroaches *Periplaneta Americana* (L).

(Blattodea : Blattidae)

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Abstract: The results indicated the effectiveness of Aggregation pheromone to reducing the amount of toxic substance to environment by mixing the pesticides with pheromone and less than recommended rates and gave effective results. The results indicated that the treatment of adult foods with Maxforce, insect growth regulator(Applaud) and Neem oil in different concentrations had an inverse relation between the concentrations used and the time duration needed to adult mortality. The results confirmed that the addition of the Pheromone Extract to the Pesticides had the effect of reducing the amount of the toxic substance entering the environment as well as reducing the time required for killing. The results indicate the adult mortality percentage of american cockroches when using 1 g of Maxforce reached to 100% after 12 days compare with two days when added 0.5ml. aggregation pheromone with pesticide that used.

1-Introduction:

Cockroaches are mechanical vector for different pathogens[1], it was common household insects that live in human environments in contact with their food and tools as they can be seen anywhere that is used or inhabited by humans,



especially where they are stored or eaten foods[1]. Worldwide, there are about 4,000 types of cockroaches that are classified into a number of Dictyoptera families [2].

Insects are highly sensitive to some of the stimuli that are emitted from the environment in which the insect is present. Certainly, the pheromones are one of the most important sensory stimuli in the insect environment[1]. The behavior of the insects is programmed behavior and the release of aggregation pheromones stimulates the behavior of members of the same species and increases their numerical density near the source of the insect. , And the benefit of these groups include defense against predators or overcome the resistance of the host plant as well as attract members of the sexes and thus increase the chances of mating and reproduction [3].

The importance of the American cockroaches due to its strong relationship with the human environment is one of the most harmful insects to it[1],Several methods have been used to control this insect, but in practice the use of chemical pesticides remains the most efficient in terms of low economic cost, efficiency in killing and rapid access to results. In this area, widespread use and dependence on insecticides to reduce their damage,Where homes are suitable environment for reproduction of cockroaches [1] , has led to the development of resistance to these pesticides especially in the american cockroches and this is the greatest threat to the workers in the pest control[4]. The difficulty of controlling the american cockroaches with insecticides are two factors, the first,appear tolerance strains of cockroaches to pesticides ie the physiological resistant strains because the presser selaction of pesticide, and the other related to the behavior of the refractory cockroachesto pesticides. These conditions either require increasing the dosage that used or production new formulation

contain activation materials that increase their effectiveness and to create new insecticides that are compatible with the behavior of the cockroaches to reduce their purgative properties [5].that two reasons requiring further study and continuous research to produce products that meet the above mentioned purposes .

Recent research has pointed to the need to control the cockroaches in ways that include the use of effective and safe chemicals such as the use of under-lethal doses of high-efficiency, highly specialized insecticides or growth regulators that cause selective physiological and behavioral changes in target organisms and with lower effects on Non-target organisms, especially vertebrates, can be successfully used in integrated control programs [6, 7].

2-Material and methods:

For the purpose of obtaining a laboratory colony of the American cockroaches, which is the most common type in the survey of species, the adult was collected and after confirmation of the diagnosis , placed in circular plastic containers diameter of 50 cm and height of 20 cm covered with a cover buckle after coating the upper edge of the upper face with Vaseline to prevent The adult escape and under the fixed conditions of temperature of 22-24 C and a relative humidity of $45 \pm 5\%$. The containers were provided with shelters of thick paper, which consisted of four pieces of paper with a distance of 4 x 12 cm. Several folds were folded in the form of a letter W and placed on top of each other after placing a paper separator from the same paper material and all bound with a paper belt. The syringes were fed using an equal mixture of biscuits and milk powder. Water was supplied with pipes at the end of which a piece of cotton was placed horizontally to ensure that the cotton was still wet .

The insects were collected by traps made of cardboard[1] ,In the research experiments, the recommended concentration was used (1 g / m²) [1] , where the taste test was performed after the feace collection and the aggregation pheromone was extract[1] , using a(choice test), ie, giving achance to the nutritions individuals either to the Maxforce Gel or original food, and three replicates were performed. In which the members of the group were provided with only the original food. The number of losses per day was calculated up to 30 days after the transaction.

The amount of 1 g of the pesticide was placed on filter paper inside a petri dish in the middle of the test basin. 20 adults were released into the basin and the pesticide was removed after 24 hours of treatment. The test was monitored daily until the mortality was stopped.

Applaud used as 25 WP buprofezin. after a series of initial experiments, to determine a number of concentrations were effect in adults cockroaches at a concentration of 100, 500, 1000 mg / L. The test was mixed with 2.5 g of biscouite powder and 2.5 g of milk powderedWith 5 mL from each concentration until the dough is obtained and then put it with the water tube in the middle of the test basin and release 20 adults of the american cockroches and with three replicates. The comparison treatment was the release of 20 adults cockroches(at age the first three days of emergence) in another basin containing only original food and water, the inner edges and the top of the test basin are painted with a material vaseline to prevent the escape of cockroaches during the test period and after 24 hours to remove the pesticide and replaced with the main food and took the results up to 30 days.

A number of active concentrations of Neem oil were identified in adult american cockroches. after a series of initial experiments, the concentration was

prepared (50 ,100, 150) mg / L. The test was done by mixed 1 g of mixture milk and biscuate with 1 ml of the above concentrations, To obtain the dough and then put it with the water tube in the middle of the test basin, 20 adult american cockroches were released and three replicates used for each concentration . The control treatment was the same number of adults in another basin containing only original food and water. Vaseline used to prevent the escape of cockroches along the test period.after 24 hours, the pesticide was removed from the treatment and replaced with the main food and the results were taken up to 30 days.

To determine the effect of adding the pheromone extract in increasing the efficiency of toxic baits, mix 0.5 mL of the optimum concentration of the pheromone extract (2 gm / 25 ml hexane), the concentration that attracts the highest number of american cockroches with the weight of the pesticide Maxforce (1, 0.5, 0.25 G) as well as with the three concentrations selected for Applaud and Neem oil growth regulators. The treatment of the comparison was the release of cockroches in the basin contain only original food and water .

In another experiment ,mixed 0.5ml pheromone extract with 1 g of Maxforce to reduced the amount of pesticide to 0.5 and 0.25 g / m and the same amount of pheromone extract was retained.Pheromone 0.5 mL was added to the baits that treated with chitin synthesis inhibitor , Add 0.5 ml of pheromone extract to the baits prepared by using Neem oil .

Note that the above tests were conducted after 24 hours of the mixing process for the disposal of organic solvent.

3-Results and discussion:

The results in Table (1) indicate that the adult mortality percentage of the american cockroches when using 1 g of the Maxforce has increased overtime. Two days after the bait was placed, the percentage of mortality was 10% and increased after 4, 6 days to reach 30, 40% respectively and this percentage was increase with time to reached 100% after 12 days of pesticide use. We note from the same table that when adding 0.5 ml of the crude aggregation pheromone extract with 1 g of the Maxforce, the percentage of mortality is 100% after two days of the use of the bait. When the same amount of pheromone is maintained and the pesticide is reduced to 0.5 g, the mortality percentage reduce to 40% after two days of treatment and this percentage increased progress of the experiment to 100% after 8 days of treatment, either when reducing the amount of pesticide to 0.25 g and the persistence of the amount of pheromone 0.2 ml, the percentage mortality reached 10% after two days of On the sixth day, the percentage mortality was 50%, while on the tenth day the percentage mortality was 100%. from this it can be concluded that the use of the extract of aggregation pheromone of the assembly has reduced the amount of insecticide that entering the environment with quick results. In the first case, the use of pheromone reduced the time required to control from 12 days to two days.

When the pesticide was reduced to 0.5 g and 0.25 g, ,the complete control of all insect done after 8,10 days respectively. On the other hand, we note from the same table that the use of aggregation pheromonelead to increase in the percentage mortality and in all time categories, noting that the percentage of mortality reached 0% in the control treatment, in all time categories used in the experiment. The results of the statistical analysis showed that there were highly significant differences in the rates of mortality according to the concentrations of the pesticide. As for the differences in the mortality rates for the number of

days and according to the same table, there was no significant differences in the second and fourth days between the weight of 1 gm pesticide with out pheromone and 0.25 g of pesticide with pheromone, either another days have been significant difference between them in the rates of mortality. The study agreed with [8], referring to the effectiveness of the Sumaiton insecticide when it was associated with aggregation pheromone, as the use of pheromone reduced the concentrations required for control through the possibility of pheromone to reduce the ability of pesticides to expulsion and ventilation.

[7] indicated that there is no taste so far that attracts the cockroches for more than a few centimeters. [9]say that the preparation of baits should be attractive not alone to be efficient in the attraction, on this basis that the addition of aggergation pheromone to the baits increase the attractiveness and reduce the alienation of the cockroaches. [10]pointed out that the extract of aggregation pheromone in German cockroaches strengthened the performance of poisonous baits and then increased the rate of mortality

Table (1): Effect the use of the Maxforce and addition the aggregation pheromone at the mortality percentage of adult american cockroaches *Periplanetaamericana*(L).

%mortality					
No.of days	Maxfoorcewith out pheromone	Maxforce 1gm with pheromone	0.5gm Maxforce with pheromone	Maxforce0.25gm with pheromone	Cont rol
2	a 10 A	100 B	a 40 C	a 10 A	
4	b 30 A		b 50 B	b 30 A	
6	c 40 A		c 60 B	c 50 C	
8	d 60 A		d 100B	d 80 C	
10	e 80			e 100	
12	f 100				

The lowercase letters in the table indicate the vertical direction and the large letters inthe horizontal direction on the mean differences in the means of 0.05.

Through the results shown in Table (2) it is clear from the use of various concentrations of the chitin synthesis inhibitor Applaud led to control of the american cockroches and different rates when using the concentrations of all showed that the mortality percentage increases with the progress of time when the use of concentration 100 ppm the mortality percentage was 10% after 2 days from treatment and increased this percentage to 60% after 16 days of treatment and then stopped killing until the end of the 30 days of follow-up. When the concentration increased to 500 ppm, the rate of mortality was 10%. Two days after the treatment, and increased to reached to 70%, after 12 days of treatment, while the use of the high concentration of(1000 ppm) resulted in 30% mortality. After two days of treatment and increased to 100% after 8 days. It is clear that the concentration of 100 and 500 ppm did not lead to 100% killing even after contenuous monitoring the treatment. When the concentration increased to 1000 ppm, the mortality rate was 100%. The results of the statistical analysis showed significant differences in the mortality percentage between the different concentrations of the chitin synthesis inhibitor. As for the difference in mortality percentages depending on the days, it was observed that the differences in the second day were not significant between the concentration of 100 ppm and 500 ppm. There are significant differences between them. [11]obtain the use of Applaud in the treatment of the late stage of nymph of the German cockroches, the mortality percentage up to 35% at the weight of 0.1 g and increased to 66.6% at the weight of 0.5 g, while the researcher did not mention the length of time and thus the adult emergence rate inversely proportional with concentrations.[12]stated that the exposure

of adults cockroaches to the shelters treated with the inhibitor synthesis of chitindiflubenzuron effective effect as a pesticide.

[13] obtained that the insect growth regulators interfere with the last stages and acts to deform the ootheca and inhibition of hatching in German cockroaches.

Table (2): Effect of insect growth regulator Applaud at the mortality percentage of adult american cockroaches *Periplaneta americana*(L).

%mortality				
No.of days	Applaud 100 ppm	Applaud 500 ppm	Applaud 1000 ppm	Control
2	a 10 A	a 10 A	a 30 B	0
4			b 60	0
6	b 20 A	b 40 B	c 80 C	0
8	c 30 A	c 50 B	d 100 C	0
10	d 50			0
12		d 70		0
14				0
16	e 60			0
18				
20				

The lowercase letters in the table indicate the vertical direction and the large letters in the horizontal direction on the mean differences in the means of 0.05

The results in Table (3) indicate that the rate of mortality has increased compared to the time when Applaud was mixed with 0.5 mL of the raw extract of aggregation pheromone. When use the concentration 100 ppm, the mortality percentage is 20% after two days of treatment. The percentage of mortality increased by 70% on the tenth day. The mortality percentage was 100% on day 14, and in the concentration of 500 ppm, The percentage of mortality in the second day was 40% and reached to 100% on the sixth day of the treatment, while the use of the concentration of 1000 ppm resulted in the percentage mortality on the second day 60% and increased on the fourth day to 100%. It is

clear that the three concentrations when combined with aggregation pheromone extract obtained a 100% mortality rate at different times, meaning that the Applaud inhibitor is transformed into an eradicate effect when mixed with the pheromone extract. The percentage of mortality in the control treatment was 0% in all concentrations, [1] explained that the shelters treated with the crude extract of aggregation pheromone in concentration 2gm remains effective in attracting the members of the cockroaches during the first 20 days. The results of the statistical analysis showed significant differences in mortality rates, whether towards differences in concentrations or for the number of days.

Table (3): Effect of insect growth regulator Applaud and addition the aggregation pheromone at the mortality percentage of adult american cockroaches

Periplaneta americana(L).

%mortality				
No.of days	Applaud 100 ppm with pheromone	Applaud 500 ppm with pheromone	Applaud 1000 ppm with pheromone	Control
2	a 10 A	a 40 B	a 60 C	0
4	b 30 A	b 70 B	b 100 C	0
6	c 40 A	c 100 B		0
8	d 60			0
10	e 70			0
12				0
14	f 100			0
The lowercase letters in the table indicate the vertical direction and the large letters in the horizontal direction on the mean differences in the means of 0.05				

The results in Table (4) indicate that the average percentage of mortality of the adult american cockroaches when using neem oil increased by increasing its concentration. When using the concentration of 50 ppm, the mortality percentage reached 20% on the fourth day and increased to

40, 60% in the day 6,8 respectively and the mortality rate was stopped in the 16th day from treatment in 70%, but when increase the concentration to 100 ppm The mortality rate was 30% after the 4th day from treatment, and reached its highest level on day 14 by 80% and stopped after that, while the use of a high concentration of 150 ppm resulted mortality percentage was 40% on the 4th day and increased the ratio that was obtained to 100% on the day 12. from the above it can be concluded that the concentration of 50 and 100 ppm did not achieve 100% mortality rate, even after the day exceeded 16, while the concentration of 150 ppm achieved 100% mortality rate and transfer the effect to eradicate effect. On the other hand, we note from the same table that the concentrations 50 and 100 ppm in which there is a cut in the rate of mortality with an increase in the time period, since on the seventh, tenth and 14 days there was no mortality of the adult american cockroaches and the same for the concentration of 100 ppm, we noted in the day 8th and 12th no mortality found As for the concentration of 150 ppm, we did not notice this discontinuity of the mortality rate on reading for every two days. Also, from the same table, we note that the killing rate for the three concentrations in the first two days is zero and the start of the killing from the fourth day. The results of the statistical analysis indicated significant differences between all concentrations as well as between the number of days in the percentage of mortality.

[14] Pointed, The results of the killing of *Ceratitiscapitata* were caused by the continuous penetration of the Neem oil compounds in cuticle insect.[15]say The difference in the effect of Neem oil on insects is due to factors such as the geographic difference of the tree location and the annual environmental differences of the geographical area. [16] noted

that the use of chitin synthesis inhibitor teflubenzuron led to negative results in the life of the German cockroaches, which was a decrease in the number of ootheca and the rate of hatching

Table (4): Effect of insect growth regulator neem oil at the mortality percentage of adult american cockroaches *Periplaneta americana* (L).

No.of days	%mortality			
	Neem oil 50 ppm	Neem oil 100 ppm	Neem oil 150 ppm	Control
2				0
4		a 20 A	a 30 B	0
6	a 20 A	b 40 B	b 50 C	0
8	b 40		c 70	0
10		c 70 A	d 80 B	0
12	c 60 A		e 100 B	0
14		d 80		0
16	d 70			0
18				
20	The lowercase letters in the table indicate the vertical direction and the large letters in the horizontal direction on the mean differences in the means of 0.05			

The results indicated in Table (5) that the mortality percentage increased when treating different concentrations of Neem oil with the crude extract of the aggregation pheromone, which led to control of the american cockroaches and different rates, when using the concentration 50 ppm, the mortality percentage reached to 20% from the 4th day and increased the percentage of killings on the 6th and 8th days by 40, 60%, respectively, and then stopped killing until the end of the follow-up period of 30 days, while increasing the concentration to 100 ppm, the mortality began on the second day by 20% On days 4, 6 to 30, 80%

respectively until reached to 100% in the 8th day of treatment, while the use of concentration of 150 ppm led to the mortality rate is 40% on the second day and increase to 60% in the fourth day, while the mortality rate was 100% reached in 6th day. It is clear from the same table that the cutout mortality rate is not complete after use of the aggregation pheromone extract. The results of the statistical analysis showed significant differences in the mortality percentage for the different concentrations of the growth regulator Neem oil.

Table (5): Effect of insect growth regulator neem oil and addition the aggregation pheromone at the mortality percentage of adult american cockroaches *Periplaneta americana* (L).

%mortality				
No.of days	Neem oil 50 ppm with pheromone	Neem oil 100 ppm with pheromone	Neem oil 150 ppm with pheromone	Control
2		a 20 A	a 40 B	0
4	a 20 A	b 30 B	b 60 C	0
6	b 40 A	c 60 B	c 100 C	0
8		d 70		0
10	c 50 A	e 100 B		0
12	d 60			0
14				
16				
The lowercase letters in the table indicate the vertical direction and the large letters in the horizontal direction on the mean differences in the means of 0.05				

References:

- [1] Al.Qaswini,y.m andR.A.Al-Essa.(2014).the study of life and behavioral effect assembly in the *periplanet americana*(L.).j.karbala uni.12(1)
- [2] Zhang Y, Xuan W, Zhao J, Zhu C, Jiang G (2010) The complete mitochondrial genome of the cockroach *Eupolyphagasinensis*(Blattaria: Polyphagidae) and the phylogenetic relationships within the Dictyoptera. *MolBiol Rep* 37:3509–3516.

- [3] Ahmad,R.F.and h.hussain.(1989).insect pheromone and application field.college of agriculture.baghdad uni.higher edu.press.
- [4] Cochran, D. G. 1990. Efficacy of abamectin fed cockroaches (Dictyoptera:Blattellidae) resistant to pyrethroid s. J.Econ. Entomol. 83: 1243-1245.
- [5] Ross, M.H. and K.R.Tignor. 1988. Difference in receptivity of substance secreted by *Blattellagermanica*(Dictyoptera: Blattellidae) females during the first week postecdysis. Ann. Entomol.Soc. Am. 81 :362-364.
- [6] Ghasemi, A.; J. J. Sendi and M. Ghadamyari. 2010. Physiological and biochemical effect of Pyriproxifen on the Indian meal moth *Plodia interpunctella* (Hubner) (Lepidoptera:Pyralidae). Journal of Plant Protection Research, Vol, 50, No.4.
- [7] Rust, M. K. and D.A. Reieson. 1981. Attraction and performance of insecticide bait for German cockroach control. Int.Pest control. 23 : 106-109.
- [8] Gixitt,A.E.(1980).use of aggregation pheromones in the control of German cockroach.Int.pest.Control . 22(1):7-8
- [9] Appel, A. C. (1992). Performance of gel and paste bait Products for German cockroach (Dictyoptera: Blattellidae) control : laboratory and Field Studies. J. Econ. Entomol. 85: 1176-1183.
- [10] Miller,D.M.;P.G.Koehler and R.S.Patterson.1997.Use of German cockroach(Dictyoptera:Blattellidae)fecal extract to enhance toxic bait performance in presence of alternative food sources.J.Econ.Entomol.90:483-487.
- [11] al-juborri,a.y.(2013).biological and physiological effect of insect growth regulators in german cockroaches *Blattellagermanica*(L.).thesis.college of agriculture.bagh.uni.iraq

- [12] Tsuji, H. and Y. Taneike. 1988. Insecticidal effect of diflubenzuron against cockroaches. *Jpn. Journal of Sanitary Zool.* 59: 19-25.
- [13] Schal, C. and R.L. Hamilton. 1990. Integrated suppression of cockroaches. *Ann. Rev. Entomology* .35:521-551
- [14] Adán A, Soria J, Del Estal P, Sánchez-Brunete Cand Viñuela E, 1998). Acción diferencial de dos formulaciones de azadiractina sobre los estados de desarrollo de *Ceratitiscapitata* (Diptera: Tephritidae). *Bol San Veg Plagas* 24:1009–1018.
- [15] Mordue (Luntz), A. J. 1998. Azadirachtin : a review of its mode of action in insects In : [K. Kleeberg, ed]. “Practice Oriented Results on Use and Production of Neem-Ingredients and Pheromones VII”. pp. 1-4. 7th Workshop, 1997, Druck and Graphic, Wetzlar, Germany.
- [16] Abidali ,M.H. 2006. behavioural and physiological studies on *Blattella germanica* and *Supella supellectilium* and some methods of control. Dissertation. college of agriculture .Uni. of Baghdad