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EFFICIENCY OF SOME ALTERNATIVE MATERIALS FOR CONTROLLING PINK BOLLWORM AND ASSOCIATED CERTAIN SAP SUCKERS AS NON-TARGET PESTS IN COTTON PLANTS

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ABSTRACT

The problems that insecticides can create have prompted the investigator to conduct the present study to evaluate the efficacy of some different alternative materials and the combinations of promising material with half dose of certain insecticides belonging to different chemical groups, for controlling pink bollworm and certain associated sap suckers as non-target pests to reduce the reliance on insecticides. Summarized results showed that, in 1998 season all alternative materials have slightly effective influence on infestation except Natrilo oil which resulted in an appreciable reduction in infestation in comparison with half dose of curacron, larvin and kendo (66.33, 67.55 and 69.37% reduction, respectively). The percentage of reduction ranged between 11.20% for jajoba and 54.69% for Natrilo oil.

In 1999 season, the combinations of Natrilo oil (promising material) with half dose of kendo and larvin increased their effectiveness (from 74.38 to 81.55% and from 72.31 to 76.43% reduction respectively), while the contrary was obtained with half dose of Curacron where the combination decreased the effectiveness (from 71.77 to 70.27% reduction). On the other hand, Natrilo induced a slight effect on whitefly and aphid, while it had no effect on jassid. The combinations of Natrilo with tested insecticides increased the effect of kendo and Curacron on whitefly, but the activity against aphid was slightly increased by combining Natrilo with larvin and curacron. A very weak increasing effect was appeared when Natrilo was combined with kendo and larvin against jassid.

INTRODUCTION

Bollworm; *Pectinophora gossypiella* (Saund). is serious injurious insect pest on cotton plants, so, it has become increasingly the key pests of cotton production, requiring repeated application of insecticides to reduce its destructive effect. Scientists and public in general, are now more aware of the problems that insecticides can create. Therefore, there is an urgent need, to find alternative less hazardous and cost such as mineral and natural oils, bioinsecticides and other cheaper means of pest control, to achieve safe, efficient and most effective pest control with minimal adverse side effects.

Cotton plants are liable to the attack by certain sucking pests e.g. cotton aphid (*Aphis gossypii*), Jassid (*Empoasca lybica*) and whitefly (*Bemisia tabaci*).

The combined effect of insecticide treatments against cotton bollworms and sucking insects was studied by several investigators, Khalil *et*

al. (1978-1979), Burris *et al*. (1985), Awad *et al*. (1993), Khalafalla and Abo-Sholoa (1993), Abo Sholoa *et al*. (1995), Khider *et al*. (1996) and Nassef and Watson (1999).

The need to alternative materials acting alone or as a synergistic agents to the half dose of certain insecticides, has become necessary to reduce the reliance on chemical insecticides. This need has prompted the investigator to conduct the present study to evaluate the efficacy of different alternative materials and the combination of the promising material with the half dose of certain insecticides belonging to different chemical groups, for controlling the pink bollworm and certain associated sap suckers as non-target pests.

MATERIALS AND METHODS

Experiments were conducted during 1998 and 1999 cotton growing seasons at Sakha Agricultural Research Station Farm. The cultivated cotton variety was Giza 89. In the first season the experiment included 14 treatments representing 10 alternative materials, three insecticides at half the recommended dose and the control. In the second season the experiment included 8 treatments representing one natural oil (Natrilo), the three mentioned insecticides in the first season with the same dose and three mixtures between natural oil and the same insecticides and control.

In the two seasons, treatments were distributed in a complete randomized block design with four replicates, each of one kirate area (175 m^2) were applied three times at two weeks intervals at late cotton season using knapsack sprayer with one nazzle (Mode CP3) with 300 litres of water per feddan. The first spray was applied on 3/8/1998 and on 7/8/1999 in the two seasons respectively.

The tested materials and their rates of application were as follows:

1- Natrilo (natural oil) 97%: is a blend of vegetable oil, emulsifiers and antioxidant, at rate of 2 litres/fed.
2- Mineral oil 95% (KZ-oil), at rate of of 3 litres/fed.
3- Jajobo oil EC 69% (extracted from Jajobo plant) at rate of 6 litres/fed.
4- Detergent (detergent-El-Korashia) at rate of 4.5 litres/fed.
5- Sulpher: sulphur dust at rate of 10 kgs/fed.
6- Vertimic (abamectin) 1.8% EC is a natural product, produced by the soil microorganism, streptomyces avermitilis at rate of 120 ml/fed.
7- Evisect (thiocyclam hydrogen oxalate) 50% W.S.P. is a natural product, produced by the marine annelidworm *Lumbrinerie sp.* at rate of 150 gm/fed.
8- Bio-fly is a liquid of formulated biocide which contains spores of the fungi, *Beauveria bassiana* at rate of 120 ml/fed.
9- Ecotech is a powder (10% WP) of formulated biocide which contains spores of the bacteria, *Bacillus thuringiensis* at rate of 600 gm/fed.
10- MVPII, is a liquid (20% Fl) of formulated biocide which contains spores of the bacteria, *Bacillus thuringiensis* at rate of 600 ml/fed.

11- Curacron (profenophos) 72% EC, organophosphorus compound at rate of 375 ml/fed. (recommended dose 750 ml/fed).
12- Larvin (thiodicarb) 80% DF, carbamate compound at rate of 250 gm/fed. (recommended dose 500 gm/fed.).
13- Kendo (lamdacyhalothrin), pyrethroid compound at rate of 187.5 ml/fed. (recommended dose 375 ml/fed.)
14- Curacron (profenophos) + Natrilo (Natural oil) at rate of 375 ml + 2 litres/fed.
15- Larvin (thiodicarb) + Natrilo (Natural oil) at rate of 250 gm + 2 litres/fed.
16- Kendo (lamdacyhalothrin) + Natrilo (Natural oil) at rate of 187.5 ml + 2 litres/fed.

To evaluate the effect of the tested materials against *P. gossypiella*, samples of 100 bolls per treatment (25 bolls/rep.) were taken at random and dissected. The initial percent infestation with bollworm was estimated immediately before the first spray and then boll samples and estimation of infestation level took place every week throughout the period of experiment (six weeks).

To determine the efficiency of tested materials on non-target sucking insects pests (aphid, Jassid and whitefly), fifty cotton leaves per replicate were collected randomly from bottom, middle and the top of the cotton plants (2 + 1 + 2 leaves per plant, respectively). The upper and lower leaf surfaces were examined carefully and counts of aphids, jassids and whitefly adult were done in the field. As for whitefly immatures, counts were done in the laboratory under the binocular microscope. Leaf sampling and insect counting were made just before spray then 2, 7 and 14 days after spraying. Percent reduction in population of the considered insects was calculated according to Henderson and Tiliton equation (1955). Duncan's multiple range test (1955) at 5% level was used to compare the average of different treatments.

RESULTS AND DISCUSSION

Data presented in Tables (1-6) elucidate the effect of some different alternative materials which were sprayed or dusted on cotton plants every two weeks intervals, three times through 1998 cotton season in comparison with half recommended dose of three insecticides belonging to different chemical groups curacron (organophosphate), larvin (carbamate) and Kendo (pyrethroid) against *P. gossypiella*.

Also, the effect of Natrilo oil the promising material mixed with half the dose of the same tested insecticides was studied in 1999 cotton season using the mentioned procedure in 1998 against pink bollworm and non-target sucking pests namely: whitefly (adults and immature stages), aphids and jassids.

The effect of tested treatment on *P. gossypiella* and non-target sucking pests was discussed separately.

A. Effect on pink bollworm:

Data presented in Table (1) summarized the effect of tested alternative materials and three insecticides in 1998 cotton season. Based on the reduction percentage in infestation, all alternative materials have slightly effective influence on infestation except Natrilo oil, which resulted in an appreciable reduction in infestation in comparison with half the recommended dose of Curacron, Larvin and Kendo. In term of figures the percentage of reduction ranged between 11.20% for Jajobo oil and 54.69% for Natrilo oil. On the other hand, curacron, larvin and Kendo showed high effect recording 66.33 67.55 and 69.37% reduction, respectively. It was noticed that there were significant differences between all alternative materials and control. Also tested insecticides significantly reduced larvae of pink bollworm than all alternative materials.

Table (1): Effect of tested materials on number of larvae and percent reduction of pink bollworm in 1998 cotton season.

Treatments	Rate/fed.	Mean number of larvae/100 bolls		% Reduction in infestation
		Pre-treatment	Post-treatment	
Sulpher dust	10 kg	3.00	13.50 cde	17.33
Detergent	4.5 litre	4.00	14.00 cd	35.30
Evisect	150 gm	3.00	13.00 def	20.39
Ecotech.	600 gm	3.00	11.67 fg	28.54
MVPII	600 ml	3.00	11.17 g	31.59
Bio-fly	120 ml	3.00	12.00 fg	26.51
Vertimic	120 ml	4.00	12.67 def	41.81
Mineral oil	3 litres	3.00	12.83 def	21.43
Jajobo oil	6 litres	3.00	14.50 bc	11.20
Natrilo oil	2 litres	5.00	12.33 efg	54.69
Curacron	375 ml	4.00	7.33 hi	66.33
Larvin	250 gm	5.00	8.83 h	67.55
Kendo	187.5 ml	4.00	6.67 i	69.37
Control	-	3.00	16.33 a	-

By Duncan's Multiple Range Test (DMRT), reduction, percentages followed by the same letter are not significantly different at 5% level.

In 1999 the second season, the combinations of half the dose of the three tested insecticides with Natrilo oil (the promising material) were studied.

The statistical analysis of date (Table 2) revealed that there were significant differences between all tested materials and control. Also the individuals of the insecticides and mixtures with Natrilo oil were significantly more effective than Natrilo alone, while there was no significant differences between the tested insecticides and their mixtures in spite of differences in their percent reduction.

Based on the percent reduction, the mixtures of Natrilo with Kendo and larvin were more effective than Kendo and larvin alone where the percent reductions were 81.53, 76.43, 74.38 and 72.31% respectively. On contrary, the mixture of curacron-Natrilo reduced the effect of curacron alone, since

the exhibited 70.27 and 71.77% reduction, respectively. Concerning the efficiency of the combinations of the different chemical groups with Natrilo oil, the percent reductions could be interpreted as follows:

Table (2): Effect of combination between Natrilo and insecticides on number of larvae and percent reduction of pink bollworm in 1999 cotton season.

Treatments	Rate/fed.	Mean number of larvae/100 bolls		% Reduction in infestation
		Pre-treatment	Post-treatment	
Natrilo	2 liters	4.00	7.00 b	46.15
Curacron	375 ml	4.00	3.67 def	71.77
Larvin	250 gm	5.00	4.50 de	7231
Kendo	187.5 ml	4.00	3.33 ef	74.38
Natrilo + curacron	2 litres + 375 ml	5.00	4.83 dc	70.27
Natrilo + larvin	2 liters + 250 ml	5.00	3.83 def	76.43
Natrilo + Kendo	2 litres + 187.5 ml	5.00	3.00 f	81.53
Control	-	4.00	13.00 e	-

By Duncan's Multiple Range Test (DMRT), reduction percentages followed by the same letter are not significantly different at 5% level.

The combinations of Kendo (pyrethroid) and Larvin (carbamate) with Natrilo oil increased their effectiveness, while the contrary was obtained with curacron (organophosphate) where the combination decreased the effectiveness. Also, the combination of Kendo with Natrilo seemed to get the priority in this respect followed by the combination of larvin with Natrilo.

The present results are in agreement with those of Korkor *et al*. (1998) who reported that sulpher dust induced a slight effect on cotton bollworm. Also, Korkor (1999) stated that mineral oil has a weak effect against pink bollworm.

B.Effect on non-target sucking pest:

The additional effect of sprayed materials on the existing sap sucking pests in treated plots are shown in Tables (3-6).

Because this work essentially aims to evaluated efficiency of different alternative materials against pink bollworm, so the means of percent reduction after every spray (two weeks interval between one spray to another) were used. Also general means of reduction percentage during the season were used to evaluate tested materials.

In general all tested materials were exhibited their effectiveness after 48 hours and a week after spray, while they were weak or not effective after two weeks from every spray.

Data obtained in Table (3) cleared that, according to general means of reduction, Natrilo-Kendo mixture gave the best result recording 50.37% reduction in the population of adult whitefly followed by Kendo, Natrilo-curacron and Natrilo-larvin mixtures recording 34.40, 26.54 and 19.50% reduction respectively. On the other hand, Natrilo, curacron and larvin exhibited slight effect, where they showed 11.43, 19.13 and 5.60% reduction in population density of adult of whitefly.

It is of interest to notice that the effect of all insecticides (curacron, larvin and kendo) was increased against adult whitefly when they were mixed with Natrilo oil.

With respect to the effect of the tested materials against immature stages of whitefly, according to general means of reduction, data (Table 4) revealed that Natrilo-kendo mixture, and Kendo alone induce appreciable

reduction, recording 25.49 and 21.86% reduction while the rest materials exhibited a weak reduction in the population of whitefly ranged between 14.51% (Natrilo) to 4.40% (larvin).

Although Natrilo-Kendo mixture has a slight effect on immature whitefly but, it was significantly more efficient than all tested materials. Also, there were significant differences between the tested insecticides and their mixtures with Natrilo.

It is quite obvious that the same trend of insecticidal efficacy was observed among all tested materials with the adult whitefly.

Hamid and Korkor (1998) showed that Hopo-oil M-pede, Natrilo, Naturalis and Bio-fly can have an important role in controlling whitefly, as being effective against immature stages of the whitefly.

With regard to Jassid, data obtained in Table (5) cleared that, Natrilo completely failed in reducing Jassid population. After the first spray the populations density decreased than control (0.55% reduction). While after the second and third spray the population density was increased than control (+0.98% and +1.97%). Also a very weak effect was observed with Natrilo-curacron mixture and curacron alone where they caused 8.26 and 7.65% reduction. On the other hand, the rest materials gave appreciable reduction in this respect ranged between 22.43% (Natrilo-Kendo) and 19.18% (Kendo). It is interesting to mention that Natrilo-larvin and Natrilo-Kendo mixtures had relatively the same effect against Jassid infestation. Also, no significant differences were found between Natrilo-Kendo and Natrilo-larvin mixtures, while there were significant differences between the two insecticides (curacron and larvin) and their mixtures with Natrilo.

The effect of tested materials against aphid is illustrated in Table (6). Data indicated that a slight effect was observed with curacron, Kendo-Natrilo mixture, Kendo and Natrilo where they caused percentages of reduction ranging from 17.90% (curacron) to 10.09% (Natrilo oil). On the other hand, larvin-Natrilo, larvin and curacron-Natrilo resulted in appreciable reduction and gave 34.49, 32.80 and 26.24% reduction respectively.

No significant differences between larvin-Natrilo mixture and larvin alone was noticed while it was more significantly efficient than the other tested materials against aphid. Also curacron-Natrilo mixture was more significantly efficient than curacron alone.

It is interesting to mention that, combinations of the tested insecticides with Natrilo significantly increased their activity.The effect of most of the tested materials decreased gradually till the end of the season, this means that resistance of aphid against tested materials was developed due to the use of the same compound three times during the season and due to the short time of aphid generation. Any how the mentioned results were in a good harmony with the finding of Abo-Sholoa *et al*. (1995) who stated that the repeated application of any insecticides during the same season must be avoided in order to avoid the build up of the resistance phenomenon or secondary pest outbreaks. Also, Mitchell *et al*. intervals, drastically increases the potential of insecticides tolerance within a (1991) mentioned that the

ability of cotton aphids to reproduce parthenogenetically thereby producing identical colonies at 4 to 7 days short period of time.

Summarized results showed that, most of alternative materials were failed to control pink bollworm except Natrilo oil which gave satisfactory effect on *P. gossypiella* in comparing with half the recommended dose of conventional insecticides. The combination of Natrio oil with tested insecticides increased the activity of Kendo and larvin, while the contrary was obtained in case of curacron for controlling this pest.

With respect to non-target sucking pests, Natrilo induced a slight effect on whitefly and aphid, while it had no effect on Jassid. On the other hand the combination of Natrilo with tested insecticides increased the effect of Kendo and curacron on whitefly, while the activity against aphid was slightly increased by combining Natrilo with larvin and curacron. A very weak increasing effect was appeared when Natrio oil was combined with Larvin and Kendo against Jassid.

In conclusion, it is obvious that the addition of Natrilo oil to the half dose of Kendo increased the effectiveness of Kendo against pink bollworm and the adult of whitefly where the percent reduction increased from 74.38 to 81.53% for pink bollworm and from 34.40 to 50.37% for whitefly and this in turn would minimize both of pollution and spray costs.

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فعالية بعض المواد البديلة لمكافحة دودة اللوز القرنفلية والحشرات الثاقبة الماصة المصاحبة لها كآفات غير مستهدفة على نباتات القطن

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المشاكل الناتجة من استعمال المبيدات حفزت الباحث كى يصمم هذا البحث لتقييم فعالية بعض المواد البديلة وكذلك الخلائط المكونة من المادة التى اعطت فعالية مع نصف الجرعة الموصى باستعمالها لبعض المبيدات التابعة للمجاميع الكيماوية المختلفة للمبيدات الخاصة بمكافحة دودة اللوز القرنفلية وكذلك بعض الآفات الثاقبة الماصة المصاحبة لها كآفات غير مستهدفة التى تصيب القطن وذلك لتقليل الأعتماد على المبيدات.

اظهرت النتائج المتحصل عليها فى موسم القطن 1998 أن جميع المواد البديلة المختبرة كان لها تأثير بسيط على الإصابة بديدان اللوز ما عدا زيت النتريلو الذى أظهر انخفاض واضح فى الاصابة وذلك بالمقارنة مع استعمال نصف الجرعة لكل من مبيدات الكوراكرون واللارفين والكندو حيث كانت نسبة الانخفاض لهذه المبيدات هى 66.33 ، 67.55 ، 69.37% على التوالى. وقد تراوحت نسبة الانخفاض للمواد البديلة المختبرة بين 11.20% وهى أقل انخفاض لمادة لزيت الجاجوبا وبين 54.69% وهى أعلى انخفاض لزيت النتريلو.

فى موسم 1999 ساعد مخلوط زيت النتريلو مع كل من نصف جرعة الكندو واللارفين على زيادة فعاليتهما حيث ارتفعت نسبة الانخفاض من 74.38% إلى 81.55% لمبيد الكندو ومن 72.31% إلى 76.43% لمبيد اللارفين بينما حدث العكس مع مخلوط الكوراكرون إذ قلل من فعاليته حيث انخفضت النسبة من 71.77% إلى 70.27%. ومن ناحية أخرى أحدث زيت النتريلو تأثير بسيط على الذبابة البيضاء والمن بينما لم يكن له تأثير على الجاسيد. وأيضا قد ساعد مخلوط النتريلو مع كل من الكندو والكوراكرون على زيادة فعاليتهما ضد الذبابة البيضاء بينما فعالية مخلوط النتريلو مع كل من اللارفين والكوراكرون قد زادت زيادة طفيفة ضد حشرة المن ، وبالنسبة لحشرة الجاسيد فقد أعطى مخلوطى النتريلو مع الكندو واللارفين زيادة ضعيفة جدا فى التأثير.

ويمكن القول أن إضافة النتريلو إلى نصف جرعة الكندو زادت فعاليته ضد دودة اللوز القرنفلية وكذلك الحشرة الكاملة للذبابة البيضاء حيث زادت نسبة الانخفاض من 74.38% إلى 81.53% لدودة اللوز القرنفلية ومن 34.20% إلى 50.73% للذبابة البيضاء وأن هذا المخلوط سوف يقلل كل من التلوث البيئى وتكاليف الرش وقد زاد تأثير باقى المخاليط على كل الحشرات المذكورة سابقا زيادة طفيفة ولكن لا يمكن أن يوصى باستعمالها.

Table (3): Percent of reduction or increase (+) of adult whitefly population following insecticidal applications on cotton plants.

Tested Materials	Rat/fed.	First spray					Second spray					Third spray					General mean
		No. pre spray	% reduction after				No. pre spray	% reduction after				No. pre spray	% reduction after				
			48 hr.	1 week	2 weeks	Mean		**48 hr.**	**1 week**	**2 weeks**	**Mean**		48 hr.	1 week	2 weeks	Mean	
Natrilo oil	2 litres	72	13.55	17.04	5.31	11.97 de	112	13.57	14.28	+1.78	8.69 cd	300	16.28	18.45	6.13	13.62 cd	11.43 d
Curacron	375 ml	88	15.13	10.90	6.04	10.69 e	136	7.47	5.88	5.00	6.12 cd	340	14.65	10.40	6.57	10.54 de	9.12 de
Larvin	250 gm	40	6.64	6.67	2.72	5.34 e	64	9.25	6.25	2.63	6.04 d	164	8.13	7.12	1.01	5.42 e	5.6 e
Kendo	187.5 ml	64	31.92	35.84	31.60	33.12 b	72	39.50	44.44	26.11	36.68 ab	140	40.21	40.65	19.33	33.40 b	34.4 b
Natrilo + curacron	2 litres + 375 ml	80	29.98	30.00	17.92	25.97 bc	108	28.29	33.33	15.56	25.73 b	240	32.57	36.53	14.71	27.94 de	26.54 c
Natrilo + larvin	2 litres + 250 gm	64	22.22	24.16	12.60	19.66 cd	92	26.35	21.73	5.83	17.97 c	228	31.47	27.12	4.02	20.87 c	19.5 c
Natrilo + kendo	2 liters + 187.5 ml	96	54.62	57.22	39.20	50.35 a	96	64.71	66.67	27.16	52.85 a	184	60.57	59.86	23.27	47.90 a	50.37 a
Control		56	72	60	92	74.67	92	76	184	240	166.67	240	172	208	136	172	137.78*

*** Mean number of adult whitefly per 50 leaves in control treatment throughout the period of experiment.**
By Duncan's Multiple Range Test (DMRT), means followed by the same letter are not significantly different at 5% level.

Table (4):Percent of reduction of immature whitefly population following insecticidal applications on cotton plants.

Tested Materials	Rat/fed.	First spray					Second spray					Third spray					General mean
		No. pre spray	% reduction after				No. pre Spray	% reduction after				No. pre spray	% reduction after				
			48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean	
Natrilo oil	2 litres	258	25.02	22.76	3.89	17.22 b	435	21.07	19.05	3.98	14.7 b	351	17.38	15.91	1.54	11.61 b	14.51 c
Curacron	375 ml	324	9.48	10.75	5.53	8.59 cd	537	11.42	10.58	3.60	8.53 bc	435	7.13	9.02	2.67	6.27 bc	7.80 de
Larvin	250 gm	297	7.56	5.90	0.39	4.62 d	519	4.10	8.05	2.32	4.82 c	426	5.93	4.73	0.62	3.76 c	4.4 f
Kendo	187.5 ml	348	26.48	28.77	14.00	23.08 ab	525	28.60	22.40	12.96	21.32 a	384	27.03	25.76	10.75	21.18 a	21.86 b
Natrilo + curacron	2 litres + 375 ml	405	16.80	18.40	8.38	14.53 bc	651	15.21	13.73	7.32	12.09 c	507	11.96	15.98	4.06	10.67 bc	12.43 d
Natrilo + larvin	2 litres + 250 gm	384	8.18	9.49	2.47	6.71 d	657	10.82	8.31	4.36	7.83 c	528	6.21	5.35	1.82	4.46 c	6.33 e
Natrilo + kendo	2 liters + 187.5 ml	429	32.36	30.89	17.89	27.05 a	618	29.66	31.25	19.13	26.68 a	420	28.63	27.33	12.23	22.73 a	25.49 a
Control	-	.384	369	474	675	506	675	642	696	567	635	567	522	507	591	540	560.33*

*** Mean number of immature whitefly per 50 leaves in control treatment throughout the period of experiment.**
By Duncan's Multiple Range Test (DMRT), means followed by the same letter are not significantly different at 5% level.

Table (5):Percents of reduction or increase (+) of Jassid population following insecticidal applications on cotton plants.

Tested Materials	Rat/fed.	First spray					Second spray					Third spray					General mean
		No. pre spray	% reduction after				No. pre spray	% reduction after				No. pre spray	% reduction after				
			48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean	
Natrilo oil	2 litres	464	1.32	0.00	0.34	0.55 c	320	0.68	+2.42	+1.20	+0.98 d	128	+1.56	+2.54	+1.80	+1.97 c	+0.8 d
Curacron	375 ml	392	10.90	7.42	7.11	8.48 b	252	12.27	5.75	5.62	7.88 c	94	6.91	8.24	4.64	6.60 b	7.65 c
Larvin	250 gm	464	36.93	27.24	9.06	24.41 a	292	31.39	26.79	6.42	21.53 ab	108	25.92	20.14	3.17	16.41 a	20.78 ab
Kendo	187.5 ml	300	29.20	24.04	12.34	21.86 a	182	27.88	21.70	11.03	20.20 b	64	21.87	17.97	6.63	15.49 a	19.18 b
Natrilo + curacron	2 litres + 375 ml	288	11.50	9.15	5.67	8.77 b	188	11.81	6.51	3.11	7.14 c	72	9.72	11.46	5.47	8.88 b	8.26 c
Natrilo + larvin	2 litres + 250 gm	444	37.28	27.76	12.77	25.94 a	268	35.55	25.55	9.37	23.49 a	96	24.48	21.87	4.89	17.08 a	22.17 a
Natrilo + kendo	2 liters + 187.5 ml	408	30.59	25.53	15.00	23.71 a	240	32.36	24.79	13.56	23.57 ab	82	26.82	22.25	10.93	20.0 a	22.43 a
Control	-	440	372	416	304	364	304	176	128	120	141.3	120	96	64	144	101.3	202.20 *

*** Mean number of jassid per 50 leaves in control treatment throughout the period of experiment.**
By Duncan's Multiple Range Test (DMRT), means followed by the same letter are not significantly different at 5% level.

Table (6): Percents of reduction or increase (+) of aphid population following insecticidal applications on cotton plants.

Tested materials	Rat/fed.	First spray					Second spray					Third spray					General mean
		No. pre spray	% reduction after				No. pre spray	% reduction after				No. pre spray	% reduction after				
			48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean		48 hr.	1 week	2 weeks	Mean	
Natrilo oil	2 litres	1540	26.25	19.44	+0.28	15.14 bc	1320	17.02	14.54	+2.06	9.83 d	1736	12.08	8.46	+4.67	5.29 d	10.09 d
Curacron	375 ml	1180	30.90	22.63	4.02	19.18 bc	968	35.09	26.71	2.20	21.33 bc	1220	25.13	14.51	+0.03	13.20 c	17.90 c
Larvin	250 gm	1664	51.21	48.75	7.47	35.81 ab	1316	45.36	42.98	5.89	31.41 ab	1596	47.81	38.59	7.11	31.17 ab	32.80 ab
Kendo	187.5 ml	948	15.14	9.34	5.70	10.06 c	764	18.63	13.15	4.52	12.1 cd	940	22.27	11.38	2.86	12.17 c	11.44 cd
Natrilo + curacron	2 litres + 375 ml	1796	40.82	33.34	10.62	28.26 abc	1372	41.71	37.68	6.56	28.65 ab	1652	38.72	22.46	4.24	21.81 b	26.24 b
Natrilo + larvin	2 litres + 250 gm	2280	54.02	57.61	4.14	38.59 a	1868	45.49	48.63	1.63	31.92 a	2368	48.74	44.42	5.70	32.95 a	34.49 a
Natrilo + kendo	2 liters + 187.5 ml	1756	25.37	24.59	5.38	18.45 bc	1420	15.76	21.43	2.28	13.16 cd	1788	21.39	15.82	3.93	13.71 c	15.11 cd
Control	-	1312	1772	1928	1376	1692	1376	1636	2156	1772	1854.67	1772	2288	1012	784	1361.33	1636 *

*** Mean number of aphid per 50 leaves in control treatment throughout the period of experiment.**
By Duncan's Multiple Range Test (DMRT), means followed by the same letter are not significantly different at 5% level.