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STUDIES ON THE EFFECTS OF *Bacillus thuringiensis* AND NUCLEAR POLYHEDROSIS VIRUS (NPV) FOR CONTROLLING THE COTTON LEAFWORM *Spodoptera littoralis (NOCTUIDAE : LEPIDOPTERA)*

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ABSTRACT

Effects of *Bacillus thuringiensis* and nuclear Polyhedrosis virus (NPV) mixture on certain biological aspects of *Spodoptera littoralis* were evaluated.

Both of 2nd and 4th larval instars of *Spodoptera littoralis* were used for that purpose. The mixture of both *Bacillus thuringiensis* (Dipel 2X) and nuclear Polyhedrosis virus (NPV) were slight effective against 2nd and 4th larval instars of *Spodoptera littoralis.* Generally the *Bacillus thuringiensis* treated leaves was more effective than other one of nuclear Polyhedrosis virus (NPV) in the respect of larval, pupal mortality and larval; pupal and adult duration.

This *Bacillus thuringiensis* (Dipel 2X) and nuclear Polyhedrosis virus (NPV) also reduced the fecundity of alive females and of the treated larvae of the 4th larval instar of *Spodoptera littoralis*.

INTRODUCTION

The use of insecticides may lead to biological imbalance due to the destruction of species, which attack the harmful insects. Besides the destruction of beneficial pollinator insects such as honey bees and others.

The cotton leafworm, *Spodoptera littoralis (*Boisd*.)* is considered as one of the most serious insect pests of many different Egyptian crops, where the pest attacks in heavy damage in all different parts of the host plants . The pesticidal and biological activities of *Bacillus thuringiensis* were extensively studied by several researchers, i.e. Abdel-Aziz and S. Hanan (2000) ; Abdel-Halim (1993) ; Abdel-Halim *et al* (1997) ; Abou-Bakr, H. (1997) ; Aly, *et al* (2000) ; Belisle, *et al* (1990) ; Bernhard, *et al* (1997) ; Broza, M. and Sneh, B. (1994) ; Butani, *et al* (1997) ; Chaufaux, *et al* (1997) ; Dabi, *et al* (1988) ; El-Sayed, A.K. and Lotfy, N. M (1990) ; Gadallah, *et al* (1990) ; Morris, *et al* (1996) ; Peng, *et al* (1992)

Therefore, the present work is carried out to determine the effect of *B. thuringiensis* and nuclear Polyhydrosis virus (NPV) on certain biological aspects in *Spodoptera littorals .* This can be attained by determining their possible latent effects on certain biological aspects.

MATERIAL AND METHODS

Laboratory experiments :

These experiments were carried out to study the effects of nuclear polyhedrosis virus (NPV) and *Bacillus thuringiensis* (*B.T.*) on different biological aspects of *Spodoptera littoralis* at different concentration of them .Oral administration was under taken by feeding the second and fourth instar larvae of *S. littoralis* on castor leaves. The effects of the mixture of these compound also were assessed. The tested biological aspects of

Spodoptera littoralis were larval mortality , deformed larvae , larval duration, pupation, pupal mortality, deformed pupae, pupal duration, emerged moths, fecundity, eggs hatchability and moth longevity.

Insect culture:

The original culture of Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd.) were obtained from Plant Protection Research Institute in Dokki, Giza, Egypt which reared on castor bean leaves. The culture was maintained at 28+2 ºC and 55+5 % R.H. The progeny of these insects together with occasional fresh supplies of eggs, formed the basis of a culture designed to provide insects used in the present investigation.

Mortality was corrected according to Abbott's formula (1925) before probit analysis.

The tested compounds :

Two compounds were tested solely and together, they were:-

Polyhedrosis virus :

The production, preparation, formulation, testing and application of a microbial pesticide according to Mckinley (1985) rate of 5×10^{12} / feddan. (300 gm /200 L. water) feddan.

Bacterial bioinsecticide :

B. thuringiensis var . Kurstaki as Dieple 2x (32×10^3 IU/ mg. . The compound was used at the rate of 300 gm powder. (300 gm /200 L. water).

Statistical analysis:

The entire assays were repeated two times each and the results were combined for statistical analysis. The results are presented as percentages, although actual means numbers of insects were used for statistical tests. Statistical significance was determined by analysis of variance (T-test at P.0.05) using the software package Costat. Results are recorded as mean ± standard deviation (SD) according to Snedecor,(1971).

RESULTS AND DISCUSSION

Effect of, *B. thuringiensis* and nuclear Polyhedrosis virus (NPV) mixture on certain biological aspects of *Spodoptera littoralis* treated in 2nd larval instar.

When 2nd larval instar of *Spodoptera littoralis* were fed on castor oil leaves treated with the mixture of *B. thuringiensis (Bacterial pathogen) and nuclear Polyhedrosis virus (NPV),* many biological aspects were affected (Tables 1 , 2 and 3). It is clear from the previous Tables, that the percentages means of larval mortality increased by increasing the mixture concentrations. The general averages of the two tested seasons in Table 3.A, were 60, 44.5, 36.5, 27 and 11.5 % at the concentrations of 100, 75, 50. 25 and 12.5 % of the mixture respectively, compared to no mortality percentages in control treatment. On the other hand, the general deformed larvae percentage mean were 2.5, 2, 2, 2.5 and 2 % at concentrations of 100, 75, 50. 25 and 12.5 % respectively, compared to undeformed larvae in control treatment.

According to the data presented in table (1, 2 & 3), it is clear that a significant prolongation in larval duration periods of *S. littoralis* insect were noticed by decreasing of the tested Bacterial and viral mixture concentrations the general obtained larval duration were 10.6 ± 0.54, 10.8 ± 0.58, 11.2 ±

0.64, 11.6 ± 0.62 and 12.2 ± 0.63 at concentrations of 100, 75, 50. 25 and 12.5 % days respectively (Table 3B), compared control (16 days).

Table (1): Effect of *B. thuringiensis* (Diple 2X) and nuclear ployhedrosis virus (SNPV) mixture on certain biological aspects of 2nd instar of *Spodoptera littoralis* (Boisd) during 2004 at different concentrations of the compound.

(A)

Concent.	Larval Mortality in %	ormed Larvae in %	Pupation in %	Pupal Mortality in %	Deform. Pupae in %	Emerged Moths in %	Deform. Moths in %
A+B 100%	65%	4%	31%	6%	0%	20%	5%
A+B 75%	43%	1%	56%	6%	4%	42%	4%
A+B 50%	35%	2%	63%5	8%	0%	49%	6%
A+B 25%	25%	3%	72%	9%	4%	55%	4%
A+B 12.5%	10%	3%	87%	10%	5%	67%	5%
Untreated	0%	0%	100%	0%	0%	100%	0%

(B)

Concent.	Larval Duration in(days) mean±S.E.	Pupal Duration in(days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in%	Moth Longevity in(days)	
					♀	♂
A+B 100%	11.4 (± 0.50)	6.4 (± 0.24)	316 (±51.35)	56.63%	11.7 (±0.43)	9.11 (± 56)
A+B 75%	11.8 (± 0.58)	7 (± 0.44)	426 (±53.99)	66%	11.72 (±0.45)	9.15 (±0.56)
A+B 50%	12 (± 0.54)	7.8 (± 0.2)	537 (±164.17)	66.6%	11.75 (±0.47)	9.1 (±0.58)
A+B 25%	12.4 (± 0.67)	8 (± 0.31)	675 (±135.15)	69.03%	11.77 (±0.48)	9.21 (±0.66)
A+B 12.5%	13 (± 0.77)	8.2 (± 0.37)	980 (±248.18)	72.04%	12 (±0.53)	9.23 (±0.72)
Untreated	16	9.8	2499	97.47%	9.28	8.85

A = (NPV) 5x 10^{12} PIB / larvae **B = *B.thuringiensis* (Diple 2X) IU**

F {5%) = 6.420 **LSD = 1.824**

Also pupal stage, which resulted from treated 2nd larvae instar of *S. littoralis*, with this mixture were affected as shown in Tables (1 , 2 & 3).The general percentages averages of pupation were increased by decreasing the concentrations of mixture. The pupation averages were 37.5, 53.5, 61.5, 70.5 and 86.5 % at mixture concentrations of 100, 75, 50. 25 and 12.5 % respectively, compared to 100 % pupation in control treatment (Table 3A). While, the mean percentages of pupal mortality were 5.5, 5, 5.5, 7 and 10 % at the previously mentioned concentrations respectively, compared to no mortality for the control. Also, the mean percentage of deformed pupae were reduced to 0, 4, 0, 2 and 5 % at the concentrations of 100, 75,50, 25 and 12.5 % respectively, compared to no deformed pupae for the control larvae (Table 3A).

Table (2): Effect of *B. thuringiensis* (Diple 2x) and Nuclear Ployhedrosis virus (SNPV) mixture on certain biological aspects of 2nd instar of *Spodoptera littoralis* (Boisd) during 2005 at different concentrations of the compounds.

(A)

Concent.	Larval Mortality in %	Deformed Larvae in %	Pupation in %	Pupal Mortality in %	Deform. Pupae in %	Emerged Moths in %	Deform. Moths in %
A+B 100%	55%	1%	44%	5%	0.0%	33%	6%
A+B 75%	46%	3%	51%	4%	4%	40%	3%
A+B 50%	38%	2%	60%	3%	0.0%	51%	6%
A+B 25%	29%	2%	69%	3%	0.0%	60%	4%
A+B 12.5%	13%	1%	86%	10%	5%	68%	3%
Untreated	0.0%	0.0%	100%	0.0%	0.0%	100%	0%

(B)

Concent.	Larval Duration in(days) mean±S.E.	Pupal Duration in(days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in%	Moth Longevity in(days)	
					♀	♂
A+B 100%	9.8 (± 0.58)	4.8 (± 0.37)	516 (±99.45)	57.6%	10.6 (±0.35)	8.21 (± 51)
A+B 75%	9.8 (± 0.58)	5.4 (± 0.24)	620 (±120.1)	68.06%	10.2 (±0.43)	8.14 (±0.51)
A+B 50%	10.4 (± 0.75)	5.8 (± 0.37)	757 (±154.9)	69.6%	10.8 (±0.42)	8.2 (±0.52)
A+B 25%	10.8 (± 0.58)	6.4 (± 0.24)	870 (±194.16)	77.1%	10.8 (±0.44)	8.24 (±0.67)
A+B 12.5%	11.4 (± 0.50)	6.6 (± 0.24)	975 (±210.35)	79.48%	11.2 (±0.51)	8.22 (±0.76)
Untreated	16	8.6	2250	99.28%	9.9	8.6

NB:-A = (NPV) 5x 10^{12} PIB / larvae B = *B.thuringiensis* (Diple 2X) IU
F {5%) = 5.448 LSD = 1.002

Data in table (3B), also show a significant effect of mixture of *B. thuringiensis* and nuclear Polyhedrosis virus (NPV) on the duration of the pupae produced from treated 2nd larval instar of *S. littoralis*. The pupal duration were 5.6 ± 0.30, 6.2 ± 0.34 , 6.8 ± 0.28, 7.2 ± 0.27 and 7.4 ± 0.30 days at the concentrations of 100, 75, 50. 25 and 12.5 % respectively, compared to 9.2 days obtained by the larvae in control treatment.

In the case of adults resulted from treated 2nd larval instar of *S. littoralis*, the percentages means of emerged, deformed moths, fecundity and eggs hatchability were greatly affected (Table.1, 2, 3). The general mean percentages averages in (table 3 A) of emerged moths were 26.5, 41, 50, 57.5 and 67.5 % at the previously mentioned concentrations respectively as compared to 100 % emerged moths for control. While the deformed moths were 5.5, 3.5, 6, 2 and 4 % respectively. The fecundity of females and eggs hatchability were affected, due to treatments of 2nd larvae instar with mixture of *B. thuringiensis* and nuclear Polyhedrosis virus (NPV). The eggs mean number / female were 416 ± 75.4, 523 ± 87.04, 647 ± 159.53, 772.5 ± 164.65 and 977.5 ± 229.26 at the previously mentioned concentrations respectively compared to 2374.5 eggs / female for control. Adult longevity also were affected by the treatment; whereas females longevity were 11.15 ± 0.39, 10.96 ± 0.44, 11.27 ± 0.44, 11.28 ± 0.46 and 11.6 ± 0. days and that of males were 8.66 ± 0.53, 8.64 ± 0.53, 8.65 ± 0.55, 8.71 ± 0.66 and 8.72 ±

0.74 days at mixture concentrations of 100, 75, 50. 25 and 12.5 % respectively , as compared to 9.59 days for females and 8.73 days for males at control.

Table (3):The general means of certain biological aspects of 2nd larval instar of *Spodoptera littoralis* affected by the mixture *B.thuringiensis* (Diple 2X) and Nuclear polyhedrosis virus (SNPV) throughout the two tested years (2004 & 2005) at different concentration.

(A)

Concent.	Larval Mortality in %	Deformed Larvae in %	Pupation in %	Pupal Mortality in %	Deform. Pupae in %	Emerged Moths in %	Deform. Moths in %
A+B 100%	60%	2.5%	37.5%	5.5%	0%	26.5%	5.5%
A+B 75%	44.5%	2%	53.5%	5%	4%	41%	3.5%
A+B 50%	36.5%	2%	61.5%	5.5%	0%	50%	6%
A+B 25%	27%	2.5%	70.5%	7%	2%	57.5%	2%
A+B 12.5%	11.5%	2%	86.5%	10%	5%	67.5%	4%
Untreated	0%	0%	100%	0%	0%	100%	

(B)

Concent.	Larval Duration in(days) mean±S.E.	Pupal Duration in(days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in%	Moth Longevity in(days)	
					♀	♂
A+B 100%	10.6 (± 0.54)	5.6 (± 0.30)	416 (±75.4)	57.06%	11.15 (±0.39)	8.66 (± 0.53)
A+B 75%	10.8 (± 0.58)	6.2 (± 0.34)	523 (±87.04)	67.03%	10.96 (±0.44)	8.64 (±0.53)
A+B 50%	11.2 (± 0.64)	6.8 (± 0.28)	647 (±159.53)	68.1%	11.27 (±0.44)	8.65 (±0.55)
A+B 25%	11.6 (± 0.62)	7.2 (± 0.27)	772.5 (±164.65)	73.06%	11.28 (±0.46)	8.71 (±0.66)
A+B 12.5%	12.2 (± 0.63)	7.4 (± 0.30)	977.5 (±229.26)	72.76%	11.6 (±0.52)	8.72 (±0.74)
Untreated	16	9.2	2374.5	98.37%	9.59	8.73

A = (NPV) 5x 10^{12} PIB / larvae B = *B.thuringiensis* (Diple 2X) IU
F {5%) = 5.125 LSD = 0.954

Effect of, *B. thuringiensis* and nuclear Polyhedrosis virus (NPV) Mixture of on cert, biological aspects on 4th larvae instar of *Spodoptera littoralis* treated in the 4th larvae instar :

When 4th larvae instar of *Spodoptera littoralis* were fed on treated castor oil plant leaves with mixture consists of *B. thuringiensis and nuclear Polyhedrosis virus (NPV)* several biological factors of this insect were influenced as shown in tables (4, 5, 6). From the general averages data recorded in Table (6A) it is clear that, the mean percentage of larval mortality increased by increasing the tested concentrations of the mixture . The mortality averages were 55, 42, 35, 28 and 13.5 % at the concentrations of 100, 75, 50. 25 and 12.5 % respectively compared to zero mortality in control treatment . On the other hand the percentages of deformed larvae were 2.5, 0.5, 0, and 1.5 and 0.0 % by the tested concentrations of 100, 75.50 , 25 and 12.5% respectively, compared to zero deformed larvae in control. From these results, (in table 6B) a significant prolongation in larval duration, were

noticed at concentrations of 100, 75, 50. 25 and 12.5 % . The general averages of larval periods were 6.8 ± 0.61, 6.8 ± 0.51, 7.4 ± 0.52, 7.6 ± 0.67 and 8.4 ± 0.64 days respectively, compared to 9 days for control larvae.

In case of pupal stage, which resulted from treated 4th larval instar of *S. littoralis*, with the mixture, percentage of pupation, mortality, deformed pupae and the pupal duration, were affected From table (4,5,6). The mean percentages of pupation increased by decreasing of concentrations of the mixture of *B. thuringiensis* and nuclear Polyhedrosis virus (NPV). The general averages of pupation percentages were 42.5, 57.5, 65, 70.5 and 86.5 % at concentrations of 100, 75, 50, 25 and 12.5% respectively, compared to 100 % pupation for control. While, the mean percentages of pupal mortality were 7.5, 6.5, 7. 5.5 and 5 % at the same previously mentioned concentrations respectively, compared to 2.5 % mortality for the control. Also, the mean percentages of deformed pupae were reduced to 0, 5, 0, 2 and 4.5 % at the concentrations of 100, 75, 50. 25 and 12.5 % respectively, compared to no deformed pupae for the control table (6A).

The obtained pupal durations periods were 7 ± 0.70, 7 ± 0.62 , 7.3 ± 0.72, 7.6 ± 0.62 and 7.8 ± 0.75 days at the mixture concentrations of 100, 75, 50. 25 and 12.5 % respectively, compared to 8.4 days for the control larvae Table (6B). The general averages of insect adult emergence, deformed moths, fecundity of females and eggs hatchability were greatly influenced when the 4th larval instars of *S.littoralis* treated with (table. 6). At concentrations of 100, 75, 50. 25 and 12.5 % of *B. thuringiensis* and nuclear Polyhedrosis virus (NPV) mixture. The mean percentages of emerged moths were 29, 42, 53.5, 60 and 74.5 % respectively compared with 97.5% by control. The deformed moths percentages were 6.5, 4, 4.5, 3 and 2.5 % respectively (table 6A). The fecundity and eggs hatchability of adult females also were affected, by treating the 4th larval instars with this mixture (table 6B). The mean numbers of eggs per / female were 497 ± 58.95, 583 ± 72.21, 698.5 ± 167.64, 796.5 ± 175.64 and 902.5 ± 239.15 eggs/females at the previously mentioned concentrations, of the teasted bio-mixture, respectively compared to 2250 eggs / female in control treatment. The means of egg hatchability as percentages were 43.3, 52.59, 60.51, 67.14 and 71.78 %, while it was 98.66 by control. The females longevities were 6.71 ± 0.23, 6.86 ± 0.33, 7.06 ± 0.40, 7.21 ± 0.57 and 6.84 ± 0.48 days and that of males were 5.04 ± 0.27, 5.71 ± 0.44, 6.12 ± 0.53, 6.54 ± 0.54 and 6.90 ± 0.23 days at concentrations of 100, 75, 50. 25 and 12.5 % of the mixture respectively, as compared to 9.1 days in females and 8.8 days in males for control (table 6B).

In the present study, *Bacillus thuringiensis* and nuclear Polyhedrosis virus (NPV) against 2nd larvae instar of *S. littoralis* had slightly effects. On the other hand the mean percentage of pupation and adult emergence produced from the 2nd and 4th instars larvae of *S. littoralis* which fed on castor oil leaves treated with different concentrations of *Bacillus thuringiensis* and nuclear Polyhedrosis virus (NPV) were greatly affected. From the foregoing results, it could be concluded that in all cases, larval mortality increased by increasing in the concentrations of the mixture of the bacterial. On the contrary both larval and pupal durations decrease by increasing

concentrations of the tasted bioinsecticidal compounds. In respect to adult stage, increasing concentrations led to decrease in female fecundity and adult longevity. All experiments proved that the effect of treatment with these compounds on the insect was higher when the treatments were carried out on the 2nd larval instar than in the 4th one. The general highest percentage of larval mortality was obtained when the larvae treated in the 2nd instar with the tested mixture consists of *B.thuringenal* and NPV. Concentration of 100

Table (4): Effect of *B. thuringiensis* (Diple 2x) and Nuclear Ployhedrosis virus (SNPV) mixture on certain biological aspects of 4th instar of *Spodoptera littoralis* (Boisd) during 2004 at different concentrations of the compounds.

(A)

Concent.	Larval Mortality in %	Deformed Larvae in%	Pupation in %	Pupal Mortality in %	Deformed Pupae in %	Emerged Moths in %	Deformed Moths in %
A+B100%	54%	3%	43%	7%	0%	31%	5%
A+B 75%	40%	1%	59%	6%	4%	45%	4%
A+B 50%	32%	0%	68%	8%	0%	54%	6%
A+B 25%	23%	1%	76%	7%	4%	62%	3%
A+B12.5%	8%	0%	92%	8%	3%	76%	5%
Untreated	0%	0%	100%	5%	0%	95%	0%

(B)

Concent.	Larval Duration in (days) mean±S.E.	Pupal Duration in (days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in %	Moth Longevity in(days)	
					♀	♂
A+B 100%	5.8 (± 0.37)	6 (± 0.97)	514 (±58.452)	75.36%	6.3 (±0.13)	4.08 (± 32)
A+B 75%	5.8 (± 0.37)	6 (± 0.54)	626 (±54.65)	67.09%	6.6 (±0.32)	5.21 (±0.57)
A+B 50%	6.2 (± 0.3)	6.2 (± 0.63)	737 (±152.99)	69.9%	6.6 (±0.71)	5.63 (±0.35)
A+B 25%	6.4 (± 0.67)	6.4 (± 0.50)	873 (±196.56)	77.09%	6.53 (±0.81)	6.40 (±0.16)
A+B 1 2.5%	7.6 (± 0.68)	6.8 (± 0.58)	965 (±254.55)	79.06%	6.68 (±0.43)	6.82 (±0.24)
Untreated	9	8.2	2240	98.08%	9.6	9.2

NB:-A = (NPV) 5x 10^{12} PIB / larvae **B = *B.thuringiensis* IU**
F {5%) = 9.507 **LSD = 1.872**

Table(5): Effect of *B. thuringiensis* (Diple 2x) and Nuclear Ployhedrosis virus (SNPV) mixture on certain biological aspects of 4th instar of *Spodoptera littoralis* (Boisd) during 2005 at different concentrations of the compounds.

(A)

Concent.	Larval Mortality in %	Deformed Larvae in %	Pupation in %	Pupal Mortality in %	Deformed Pupae in %	Emerged Moths in %	Deformed Moths in %
A+B 100%	56%	2%	42%	8%	0%	27%	7%
A+B 75%	44%	0%	56%	7%	6%	39%	4%
A+B 50%	38%	0%	62%	6%	0%	53%	3%
A+B 25%	33%	2%	65%	4%	0%	58%	3%
A+B 12.5%	19%	0%	81%	2%	6%	73%	0%
Untreated	0%	0%	100%	0%	0%	100%	0%

(B)

Concent.	Larval Duration in(days) Mean ±S.E.	Pupal Duration in(days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in %	Moth Longevity in(days)	
					♀	♂
A+B 100%	7.8 (± 0.86)	8 (± 0.44)	480 (±59.45)	29.3%	7.12 (±0.34)	6 (± 23)
A+B 75%	7.8 (± 0.66)	8 (± 0.70)	540 (±89.77)	38.1%	7.13 (±0.34)	6.21 (±0.31)
A+B 50%	8.6 (± 0.74)	8.4 (± 0.81)	660 (±182.29)	51.13%	7.53 (±0.1)	6.62 (±0.72)
A+B 25%	8.8 (± 0.67)	8.8 (± 0.74)	720 (±154.73)	57.2%	7.9 (±0.33)	6.68 (±0.98)
A+B 12.5%	9.2 (± 0.6)	8.8 (± 0.93)	840 (±223.75)	64.5%	7 (±0.54)	6.99 (±0.23)
Untreated	9	8.9	2260	99.24%	8.6	8.4

A = (NPV) 5x 10^{12} PIB / larvae **B = *B.thuringiensis* IU**
F {5%) = 5.224 **LSD = 1.335**

Table (6) The general means of certain biological aspects of 4th larval instar of *Spodoptera littoralis* affected by the mixture *B.thuringiensis* (Diple 2X) and Nuclear polyhedrosis virus (SNPV) throughout the two tested years (2004 & 2005) at different concentration.

(A)

Concent.	Larval Mortality in %	Deformed Larvae in %	Pupation in %	Pupal Mortality in %	Deformed Pupae in %	Emerged Moths in %	Deformed Moths in %
A+B 100%	55%	2.5%	42.5%	7.5%	0%	29%	6.5%
A+B 75%	42%	0.5%	57.5%	6.5%	5%	42%	4%
A+B 50%	35%	0%	65%	7%	0%	53.5%	4.5%
A+B 25%	28%	1.5%	70.5%	5.5%	2%	60%	3%
A+B 12.5%	13.5%	0%	86.5%	5%	4.5%	74.5%	2.5%
Untreated	0%	0%	100%	2.5%	0%	97.5%	0%

(B)

Concent.	Larval Duration in(days) mean±S.E.	Pupal Duration in(days) mean±S.E.	Fecundity no. of egg /female Mean±S.E.	Hatch. in%	Moth Longevity in(days)	
					♀	♂
A+B 100%	6.8 (± 0.61)	7 (± 0.70)	497 (±58.95)	43.3%	6.71 (±0.23)	5.04 (± 0.27)
A+B 75%	6.8 (± 0.51)	7 (± 0.62)	583 (±72.21)	52.59%	6.86 (±0.33)	5.71 (±0.44)
A+B 50%	7.4 (± 0.52)	7.3 (± 0.72)	698.5 (±167.64)	60.51%	7.06 (±0.40)	6.12 (±0.53)
A+B 25%	7.6 (± 0.67)	7.6 (± 0.62)	796.5 (±175.64)	67.14%	7.21 (±0.57)	6.54 (±0.54)
A+B 12.5%	8.4 (± 0.64)	7.8 (± 0.75)	902.5 (±239.15)	71.78%	6.84 (±0.48)	6.90 (±0.23)
Untreated	9	8.4	2250	98.66%	9.1	8.8

A = (NPV) 5x 10^{12} PIB / larvae **B = *B.thuringiensis* (Diple 2X) IU**
F (5%) = 9.777 **LSD = 1.373**

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دراسة تأثير البكتريا و الفيرس النووى فى مكافحة دودة ورق القطن (الليليات - حرشفيات ألاجنحه)

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أجريت هذه الدراسة لدراسة تأثير مخلوطً مع المركب الحيوي (فيرس البولي هيدروذس فيرس) وبكتريا الديبل 2X على بيلوجية دودة ورق القطن.

تأثير مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمرالثانى لحشرة دودة ورق القطن :

ا- كان مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) تأثيرا على يرقات العمر الثانى للسلالة الحساسة لحشرة دودة ورق القطن أسبودبترا ليتوراليس ، حيث أ نة سجل معدل وفيات وصل الى (٦٠%) عند أعلى تركيز (١٠٠%) سجل معدل وفيات وصل الى (٤٤,٥ و ٣٦,٥%) عند تركيز (٧٥و٥٠%) مقارنتا ٠% وفيات فى اليرقات الغير المعاملة.

ب- كان مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمرالثانى تأثير معنوي على قصر عمر اليرقات وصل ال(١٠,٦يوم)و أعمار عذارى وصلت إلى (٥,٦يوم) وأعمار الذكور والإناث وصلت إلى (٨,٦٦ , ١١,١٥يوم) عند أعلى تركيز (١٠٠%) بعد معاملة يرقات العمر الثاني اليرقلحشرة دودة ورق القطن مقارنتا (١٦يوم : ٢و٩يوم : ٨,٧٣ ، ٩,٥٩يوم) باليرقات الغير المعاملة .

ج_ وجد أن لنبات مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمرالثانى تأثيرا فعالا على عدد البيض وصلنت إلى (٤١٦ بيضة/لأنثى واحدة) ونسبة فقس البيض وصلت إلى (٥٧,٠٦) عند تركيز (١٠٠%) فى الإناث الناتجة عن معاملة العمر الثاني اليرقلحشرة دودة ورق القطن مقارنتا (٢٣٧٤,٥ بيضة/لأنثى واحدة ٩٨,٣٧%) باليرقات الغير المعاملة.

تأثير مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمرالرابع لحشرة دودة ورق القطن :

ا-كان مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) تأثيرا على يرقات العمر الرابع للسلالة الحساسة لحشرة دودة ورق القطن أسبودبترا ليتوراليس ، حيث أ نة سجل معدل وفيات وصل الى (٥٥%) عند أعلى تركيز (١٠٠%) سجل معدل وفيات وصل الى (٤٢ و ٣٥%) عند تركيز (٧٥و٥٠%) مقارنتا ٠% وفيات فى اليرقات الغير المعاملة .

ب- كان مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمر الرابع تأثير معنوي على قصر عمر اليرقات وصل ال(٦,٨يوم)و أعمار عذارى وصلت إلى (٧يوم) وأعمار الذكور والإناث وصلت إلى (٥,٠٤ , ٦,٧١يوم) عند أعلى تركيز (١٠٠%) بعد معاملة يرقات العمر الرابع اليرقلحشرة دودة ورق القطن مقارنتا (٩يوم : ٨,٤يوم :٨,٨ ، ٩,١يوم) باليرقات الغير المعاملة .

ج_ وجد أن مخلوط كل من الفيرس النووى (NPV) ، البكتريا (دايبل ٢X) على العمر الرابع تأثيرا فعالا على عدد البيض وصلنت إلى (٤٩٧ بيضة/لأنثى واحدة) ونسبة فقس البيض وصلت إلى (٤٣,٣) عند تركيز (١٠٠%) فى الإناث الناتجة عن معاملة العمر الرابع اليرقلحشرة دودة ورق القطن مقارنتا (٢٢٥٠بيضة/لأنثى واحدة :٩٨,٦٦%) باليرقات الغير المعاملة