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Microbial Control on Common Cutworms (Lepidopetera: Noctuidae)

Jaisuk L. and S. Bumroongsook*

Department of Plant Production Technology, Faculty of Agricultural Technology King Mongkut Institute of Technology Ladkrabang, Bangkok 10520 Thailand.

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Agricultural production currently is targeted to reduce the use of synthetic insecticides and at the same time, to improve ecosystem and health. The use of *Bacillus thruingiensis* and nuclear polyhedrosis virus to control common cutworms was investigated which are a very destructive pest for several economic crops. The efficacy of Bt at 60 and 80 ml/20 litres of water, NPV 40 ml and 50 ml/20 litres of water and mixture of Bt:NPV(3:1 and 1:3 v/v) 40 ml/20 litres of water against different larval instar of common cutworms (*Spodopter litura*) was carried out under the laboratory condition. . The studies showed that NPV 50 ml in the 20 litres of water was the most effective on the 1st and 2nd instar larvae, mixture of the Bt and NPV ratio 3:1 had the highest percentage mortality on the 3rd instar larvae. Whereas, NPV 50ml was the most effective for the 4th and 5th instar larvae. However, these microbial control application would be expressed more effective on early larval stage of common cutworms.

Key words: *Bacillus thruingiensis*, common cutworms, nuclear polyhedrosis virus

Introduction

The common cutworms (*Spodoptera litura*) are one of the most important insect pest of various economic crops. It is also known as oriental leafworm moth, taro caterpillar, tobacco cutworm. They occur in Asia, Australia and pacific islands (Monobrullah and Shankar, 2008). The larvae are leaf feeders and destroy wide varieties of plants include, castor, cotton, tobacco, groundnut, sorghum, maize, soybean, banana, guava, brinjal, beetroot, cabbage and lotus plants. In the past, insect control depend mostly on insecticides. The synthetic insecticides decrease diversity, abundance and effectiveness of natural enemies (Zhou *et al.,* 2012). In addition, heavy insecticide application to control this pest cause insect resistance, resurgence and chemical contamination to environment.

* **Coressponding author:** Jaisuk L.; **Email:** suvarin.bu@kmitl.ac.th

Bacillus thruringiensis and *Spodoptera litura* Nuclear Polyhedrosis Virus are alternative control strategies for chemical insecticides. Bt accounted for a few percent of the global chemical market (Lambert and Peferoen, 1992). Common cutworms showed high specificity to *Spodoptera litura* Nuclear Polyhedrosis. It is safe to vertebrates, plants and non target organisms(Burges *et al.,* 1980; Groner, 1986)

Objectives: In this study we evaluate the efficacy of *Bacillus thruringiensis*(1x10^{10} CFU/ml) and *Spodoptera litura* Nuclear Polyhedrosis Virus against common cutworm larvae.

Materials and methods

Rearing common cutworms

The common cutworms were collected from lotus pond and mass rearing under the laboratory condition (34^{o}C; 68% RH). Both male and female of common cutworm were provided with 25% of honey solution. Non chemical treated lotus leaves were used as feed for these larvae. The larval stage was identified to instar 1 to 5 by using the head capsule width. These caterpillars were kept for 2 hours of fasting period before the experiment.

Experimental design

Leaf dipping assay developed by Shelton *et al.* (1993) was used to evaluate the toxicity of *Bacillus thruringiensis* (1x10^{10} CFU/ml) and *Spodoptera litura* Nuclear Polyhedrosis Virus against larval instar1-5 . The experimental design is completely randomized design with 7 treatments and 5 replications as follows:

1. Control
2. Bt 60 ml 20 litre^{-1}
3. Bt 80 ml 20 litre^{-1}
4. NPV 40 ml 20 litre^{-1}
5. NPV 50 ml 20 litre^{-1}
6. mixtures of Bt and NPV(3:1) 40 ml 20 litre^{-1}
7. mixtures of Bt and NPV (1:3 v/v) 40 ml 20 litre^{-1}

A leaf disc (5 cm) from lotus leaves was dipped for 5 seconds in the assigned biocide solution or control solution and dried at room temperature for 1 hour. Ten of the first instar larvae were placed on treated leaf disc. Each treatment was replicated for 5 times. The whole experiment was repeated for the second to the fifth instar larvae. Larval mortality was recorded every other day for 7 days. The mortality percentage was calculated.

Data analysis

The mortality percentage of larvae was subjected to one- way analysis of variance (ANOVA) and difference between means were determined by Duncan's multiple range tests (P<0.05) using SPSS package version 20.0.

Results and Discussion

The results showed that NPV 50 ml 20 litre^{-1}achieved the highest mortality of the first, second and fourth instar larvae after treatment for 7 days (Table 1-2 and Table 4). Bt 80 ml, NPV 50 ml and mixture of Bt and NPV(3:1) 40 ml had the highest mortality percentage of the 3rd instar larvae(Table 3) and Bt 80 ml and NPV 50 ml for the fifth instar larvae (Table 5). However, the data indicated that first instar was found dead on the first day after treatment and NPV 50 ml caused up to 90% mortality within 5 days of treatment (Table 1). The lesser mortality rates were found in later instar larvae (Table 1-5). Martens *et al*. (1990) showed that insecticide activity of Bt had slow toxic effect on insects. It can take quite some time for the insect pathogens to reproduce and destroy their hosts (Cory and Franklin, 2012).

Table 1 Comparision mortality percentage of the first instar larvae of common cutworms treated with Bt and NPV

Treatment (ml 20litre^{-1})	**Mortality percentage**[1] Day after treatment			
	1	3	5	7
control	0	0	0	0d
Bt 60	2	18	30	36cd
Bt 80	2	20	40	44cd
NPV 40	2	36	64	80ab
NPV 50	4	54	90	92a
Bt:NPV(3:1) 40	12	24	44	62bc
Bt:NPV(1:3) 40	4	16	60	82ab

[1]The same letter in the same column show no significant difference (p=0.05; DMRT)

Table 2 Comparision mortality percentage of the second instar larvae of common cutworms treated with Bt and NPV

Treatment (ml 20litre^{-1})	**Mortality percentage**[1]			
	Day after treatment			
	1	3	5	7
control	0	0	0	0d
Bt 60	0	10	20	36c
Bt 80	0	4	18	48abc
NPV 40	0	2	26	54abc
NPV 50	0	8	30	66a
Bt:NPV(3:1) 40	0	2	20	58ab
Bt:NPV(1:3) 40	0	0	14	46bc

[1]The same letter in the same column show no significant difference (p=0.05; DMRT)

Table 3 Mortality percentage of the third instar larvae of common cutworms treated with Bt and NPV

Treatment (ml 20 litre^{-1})	**Mortality percentage**[1]			
	Day after treatment			
	1	3	5	7
control	0	0	0	0c
Bt 60	0	6	18	40ab
Bt 80	0	16	43	55a
NPV 30	0	0	10	45ab
NPV 50	0	2	16	54a
Bt:NPV(3:1) 40	0	8	35	58a
Bt:NPV(1:3) 40	0	4	14	30b

[1]The same letter in the same column show no significant difference (p=0.05; DMRT)

Table 4 Mortality percentage of the fourth instar larvae of common cutworms treated with Bt and NPV

Treatment (ml 20litre^{-1})	Mortality percentage[1]			
	Day after treatment			
	1	3	5	7
control	0	0	0	0d
Bt 60	0	4	16	32c
Bt 80	0	4	15	40bc
NPV 30	0	0	18	58ab
NPV 50	0	18	32	70a
Bt:NPV(3:1) 40	0	2	15	52abc
Bt:NPV(1:3) 40	0	2	8	60ab

[1]The same letter in the same column show no significant difference (p=0.05; DMRT)

Table 5 Mortality percentage of the fifth instar larvae of common cutworms treated with Bt and NPV

Treatment (ml 20 litre^{-1})	Mortality percentage[1]			
	Day after treatment			
	1	3	5	7
control	0	0	0	0c
Bt 60	0	0	0	12ab
Bt 80	0	4	5	26a
NPV 30	0	0	0	18ab
NPV 50	0	0	2	30a
Bt:NPV(3:1) 40	0	0	0	14ab
Bt:NPV(1:3) 40	0	0	0	15bc

[1]The same letter in the same column show no significant difference (p=0.05; DMRT)

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