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Control of the Diamond Back-moth, *Plutella xylostella* L. and the Green Peach Aphid, *Myzus persicae* Sulzer with Insecticides and *Bacillus thuringiensis* var. *thuringiensis* Berliner

By

K. NARAYANAN [1], S. JAYARAJ [2] and T. R. SUBRAMANIAM [3]

ABSTRACT

Both DDT and dimethoate were compatible with the pathogen *Bacillus thuringiensis* var. *thuringiensis*. The combination of dimethoate with the pathogen, DDT with the pathogen and pathogen alone were on par in controlling the larva of diamond-back moth, *Plutella xylostella* L. The pathogen could not control the green peach aphid, *Myzus persicae* Sulzer. However the combination of dimethoate with the pathogen and DDT with the pathogen could control both *P. xylostella* and *M. persicae* more effectively than either of them alone.

INTRODUCTION

Research in India on *Bacillus thuringiensis* Berliner is very limited (Majumdar *et al.*, 1955; Venkataraman and Chander, 1967; Rangaswami *et al.*, 1968; Narayanan *et al.*, 1970). The present investigation was therefore, taken up to find out the efficacy of *B. thuringiensis* alone and in combination with certain insecticides in controlling the diamond-back moth, *Plutella xylostella* L. *(maculipennis* (Curtis) and the green peach aphid, *Myzus persicae* sulzer.

MATERIALS AND METHODS

A simple randomised field experiment was conducted on knol-khol crop infested with *P. xylostella* and *M. persicae* with eleven treatments mentioned in Table 1 and replicated three times. Two rounds of application were given on 20 and 35 days after planting with 300 litres of spray fluid per acre. For the purpose of assessing efficacy, the population counts of caterpillars and aphids were recorded on the 3, 10 and 17 days after each round of application on three leaves, in each of five plants selected at random per plot. The mortality of the insects with reference to the initial counts was worked out to assess the efficacy of the various treatments. The data collected in the trials were converted into corresponding angles (Arc Sine $\sqrt{\text{percentage}}$) for statistical interpretation.

RESULTS AND DISCUSSION

CONTROL OF THE DIAMOND-BACK MOTH

(i) **First round of application:** All the treatments given in the first round irrespective of whether it was pathogen alone or pathogen in combination with insecticides or insecticides alone, were found to reduce the infestation of *P. xylostella* (Table 1). Among the treatments, the pathogen at the highest

1. Instructor. 2. Director of Extension Education and 3. Registrar, Tamil Nadu Agricultural University, Coimbatore - 641003.

concentration of 4.5 litres / acre combined with dimethoate had maximum effect and was on par with the treatments of pathogen mixed with DDT and pathogen alone at the highest concentration. The percentage of reduction in these three treatments from control being 87.6, 86.7 and 86.4 respectively.

In considering the persistence of efficacy, it was found that the maximum reduction in population was observed in all the treatments within a period of three days after treatment (Table 1). The efficacy of each treatment could be assessed in the three different periods of observation. All the treatments were on par and equally effective in controlling the pest in the first three days. In the subsequent observations made 10 and 17 days after treatments, the pathogen mixed with dimethoate, pathogen alone at all concentrations and DDT mixed with the pathogen were apparently better than the other treatments in reducing the population. It is, therefore, evident from the results presented above that the treatments, *viz.*, pathogen mixed with dimethoate, pathogen mixed with DDT and pathogen alone at the highest concentration were found consistently superior to all the other treatments in all the periods of observation. When each treatment was considered in the interaction between periods and treatments, the pathogen alone in all the three concentrations, pathogen mixed with dimethoate and pathogen mixed with DDT reduced the population with equal efficacy 3 and 10 days after treatment. There was a decreasing trend in the effectiveness after 17 days.

(ii) **Second round of application:** In view of the increased population at 17 days after the first round of treatment, second round of treatment was given for the control of *P. xylostella*. A significant reduction in population was brought about by all the treatment in this case also (Table 1). Pathogen mixed with dimethoate, pathogen alone at the three levels of concentration and pathogen mixed with DDT effected significantly better control than dimethoate and DDT, the percentage of reduction being 87.4, 86.1, 74.7 and 85.4, 50.5 and 45.4 respectively. When periods were considered, the maximum reduction was effected in all the treatments in 3 days followed by 10 and 17 days after treatments, the efficacy in the former two periods was statistically on par.

When all the treatments are compared during different periods. it is evident that the pathogen at all levels of concentration and pathogen combined with insecticides were significantly superior in bringing down the population in both the periods of 3 and 10 days after treatments. It was noticed that after 17 days of the second round of application, the pathogen mixed with dimethoate and DDT was found to give significant reduction in population over the other treatments. The treatments of insecticides alone did not give appreciable reduction and the population was found to be on par with the control plots after both the rounds of treatments. It is also seen that despite the increased effect of the pathogen mixed with insecticides than the pathogen alone, there has been no

TABLE 1. Effect of *Bacillus thuringiensis* with and without insecticides in the control of *Pluttella xylostella* (Mean of three observations). (Figures in parenthesis indicate the transformed value).

Treatments	First round of treatment				% decrease from control	Second round of treatment				% decrease from control
	Caterpillar population in 3 days	10 days	17 days	Mean		Caterpillar population in 3 days	10 days	17 days	Mean	
Thuricide 90TS Flowable @ 4.50 litres / acre for both the rounds	0.33 (0.71)	0.33 (0.88)	7.00 (2.72)	1.43	86.4	0.00 (0.71)	0.33 (0.88)	14.00 (3.79)	1.79	86.1
Thuricide 90TS Flowable @ 3.37 litres / acre for both the rounds	0.66 (1.22)	0.66 (1.05)	13.00 (3.62)	1.96	81.3	0.00 (0.71)	0.00 (0.71)	25.66 (5.04)	2.15	83.3
Thuricide 90TS Flowable @ 2.25 litres / acre for both the rounds	1.66 (1.46)	1.00 (1.16)	27.00 (5.23)	2.61	75.1	0.66 (1.00)	0.00 (0.71)	54.33 (7.38)	3.03	74.7
Dimethoate @ 2 ml / litre for both the rounds	1.66 (1.46)	6.33 (2.45)	96.00 (9.81)	4.57	56.5	5.33 (2.39)	23.66 (4.73)	147.00 (11.98)	6.37	50.5
Dimethoate @ 2 ml / litre followed by Thuricide 90TS Flowable @ 4.5 litres / acre	1.66 (1.38)	10.00 (3.15)	98.66 (9.94)	4.82	54.1	0.00 (0.71)	0.00 (0.71)	40.00 (6.76)	2.58	79.9
Dimethoate @ 2 ml / litre followed by Thuricide 90TS Flowable @ 3.37 litres / acre	2.33 (1.64)	10.00 (3.06)	100.66 (10.04)	4.91	53.2	0.00 (0.71)	0.00 (0.71)	45.33 (6.76)	2.72	78.9
Dimethoate @ 2 ml / litre followed by Thuricide 90TS Flowable @ 2.25 litres/acre	1.66 (1.43)	9.33 (3.02)	103.00 (10.19)	4.88	53.5	0.66 (1.00]	0.66 (1.05)	37.66 (6.15)	2.73	78.8
Thuricide 90TS Flowable @ 4.5 litres / acre plus dimethoate 2 ml / litre for both the rounds	0.33 (0.88)	0.00 (0.71)	5.00 (2.33)	1.30	87.6	0.00 (0.71)	0.33 (0.88)	10.33 (3.27)	1.62	87.4
DDT 50% W. P. @ 2 g / litre for both the rounds	1.33 (1.29)	8.00 (2.82)	88.33 (9.40)	4.50	57.1	13.33 (3.69)	27.66 (5.11)	151.00 (12.30)	7.03	45.4
DDT 50% W. P. @ 2 g / litre plus Thuricide 90TS Flowable 4.5 litres / acre	0.33 (0.88)	0.33 (0.88)	5.66 (2.46)	1.40	86.7	1.00 (1.17)	0.66 (1.00)	11.66 (3.48)	1.88	85.4
Control	31.00 (5.64)	147.33 (12.15)	188.00 (13.72)	10.50		205.00 (14.31)	174.66 (13.25)	123.33 (11.09)	12.88	
Mean	(1.63)	(2.85)	(7.22)			(2.46)	(2.70)	(7.05)		
Difference between treatments is significant at 1% level			C. D. (P=0.05) = 0.5373)					C. D. (P=0.05) = 1.93		
Difference between periods is significant at 1% level			C. D. (P=0.05) = 0.2828					C. D. (P=0.05) = 0.98		
Difference between treatments and periods is significant at 1% level			C. D. (P=0.05) = 0.9306					C. D. (P=0.05) = 3.34		

Difference between treatments and periods is significant at 1% level

C. D. (P=0.05) = 0.2828

C. D. (P=0.05) = 0.9306

C. D. (P=0.05) = 0.98

C. D. (P=0.05) = 3.34

TABLE 2. Effect of *Bacillus thuringiensis* with and without insecticides in the control of *Myzus persicae* (Mean of three observations).

Treatments	First round of treatments				% decrease from control	Second round of treatments				% decrease from control
	Aphid population in					Aphid population in				
	3 days	10 days	17 days	Mean		3 days	10 days	17 days	Mean	
Thuricide 90 TS Flowable @ 4.50 litres/acre for both the rounds	137.33	161.66	211.66	170.22	49.8	285.33	272.00	172.33	243.22	23.9
Thuricide 90 TS Flowable @ 3.37 litres/acre for both the rounds	160.00	195.00	278.33	211.11	37.8	311.33	288.00	218.00	281.33	12.0
Thuricide 90 TS Flowable @ 2.25 litres/acre for both the rounds	160.66	200.00	243.33	201.33	40.7	275.00	256.66	222.00	251.22	21.4
Dimethoate @ 2 ml/litre for both the rounds	7.33	30.66	73.33	37.11	89.0	22.00	36.66	99.66	58.83	81.6
Dimethoate @ 2 ml/litre followed by Thuricide 90 TS Flowable @ 4.5 litres/acre	14.33	32.66	67.00	38.00	88.8	123.66	176.33	160.00	153.33	52.0
Dimethoate @ 2 ml/litre followed by Thuricide 90 TS Flowable @ 3.37 litres/acre	4.66	33.66	59.66	32.74	90.3	111.00	164.66	173.33	149.77	53.2
Dimethoate @ 2 ml/litre followed by Thuricide 90 TS Flowable @ 2.25 litres/acre	2.66	13.00	63.00	27.90	91.7	137.33	200.00	131.66	155.22	51.5
Thuricide 90 TS Flowable @ 4.5 litres/acre plus dimethoate 2 ml/ litre for both the rounds	10.00	20.33	59.00	28.44	91.6	14.00	30.33	75.00	39.88	87.5
DDT 50% W. P. @ 2 g/litre for both the rounds	69.00	101.33	176.33	115.55	65.9	135.66	170.33	177.00	161.00	49.7
DDT 50% W. P. @ 2 g/litre plus Thuricide 90 TS Flowable 4.5 litres/acre	49.66	57.66	83.66	63.66	87.2	72.33	76.66	85.66	78.22	75.5
Control	306.00	326.00	386.66	339.53		413.00	306.33	240.00	319.77	
Mean	83.78	107.00	154.70			172.7	179.9	159.5		

Difference between treatments is significant at the 1% level — C. D. (P = 0.05) = 19.99 — C. D. (= P0.05) = 36.25

Difference between periods is significant at 1% level — C. D. (P = 0.05) = 10.60 — Not significant.

Difference between treatments and periods is significant at the 1% level — C. D. (P = 0.05) = 34.30 — C. D. (P = 0.05) = 62.86

significant difference between these two sets of treatments. This indicated that the mixing of either DDT or dimethoate with the pathogen may not enhance the efficacy of the pathogen to a significant level, though the pathogen was compatible with the insecticides in that the insecticides did not cause any detrimental effect to the efficacy of the pathogen. The observations made in this study with reference to these insecticides appear support the earlier findings of Herfs (1965) that DDT and *B. thuringiensis* are compatible and that mixing of these two is possible. That the insecticide DDT is synergistic in increasing the efficacy of the pathogen reported by him, could not be noticed in the present study significantly.

Control of *Myzus persicae* : Dimethoate treatments alone and in combination with the pathogen recorded significantly less aphid infestation (Table 2). The pathogen mixed with DDT and DDT alone came next in the order of efficacy whereas the pathogen alone at all levels of concentrations proved to be less effective than the insecticides and insecticides mixed with pathogen, indicating that pathogen has very little action on aphids. The maximum reduction was effected in all the treatments in the first period of three days followed by 10 and 17 days after treatment. Besides, the interaction between various treatments and periods of observation was also significant. It is evident that dimethoate alone and dimethoate combined with pathogen were found consistently superior to all the other treatments during each of the three periods of observation in both the rounds of application. This may probably be due to the action of the insecticides which were found to be highly effective when applied alone. In the comparison of insecticides, dimethoate was found to be superior to DDT. The effectiveness of dimethoate in controlling the cabbage aphid, *Brevicoryne brassicae* L. was also shown by Shorey (1963) and Sarup *et al* (1966).

The aphid infestation was significantly lower in the plants treated with different treatments (Table 2). The efficacy of the insecticide treatments was on the same lines as obtained in the first round of treatment. However, the difference in the aphid population in different periods of observation was not significant mainly because of masking effect of ineffective treatments in the pooled statistical analysis of data. Besides the individual significant effect of various treatments, the interaction between treatments and periods of observation showed a significant effect between them.

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