

Original Research Article

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Efficacy of Bio-pesticides against Diamond Backmoth on Broccoli at Ambikapur, (Chhattisgarh)

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ABSTRACT

The present investigation entitled “Population dynamics and management of major insect-pests of broccoli (*Brassica oleracea* var *italica*) with special reference to diamondback moth (*Plutella xylostella* L)” was conducted in the Research Cum Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (C.G.) during rabi 2019-20. The insect pests aphids, DBM, tobacco leaf eating caterpillar, *Helicoverpa armigera*, leaf webber, sawfly and whitefly were reported as major insect pests on broccoli crop. The peak population of aphids (30.60/leaf), DBM (9.00/ plant), tobacco leaf eating caterpillar (2.73/ plant), *Helicoverpa armigera* (1.67/leaf), leaf webber (3.07/leaf), sawfly (3.33/leaf) and whitefly (14.93/leaf) were seen during second fortnight of January, first fortnight of February, first fortnight of February, first fortnight of February, second fortnight of January, first fortnight of February and second fortnight of January, respectively. The incidence of lady bird beetle initiated from second fortnight of December (0.33/leaf) with gradual increase and attained its peak in second fortnight of January (1.13/leaf). The population gradual decreased and reached its minimum during second fortnight of March (0.27/leaf). During the period of observations it was observed that the maximum per cent plant infestation by diamond-back moth in broccoli were found in 18th march (71.1 %) followed by 4th march (68.9%). Where as during 25th December minimum per cent plant infestation (8.9 %) were observed. The overall mean larval population recorded after first and second spray revealed that T6 (spinosad 45% SC) found best treatment in respect to other treatments because it's recorded lowest mean larval population i.e. 4.54 larvae/plant followed by NSKE 5% (6.15 larvae/plant), *Bacillus thuringiensis* 2x10⁸ (6.73 larvae/plant), *Metarhizium anisopliae* 2.8x10⁶(6.77 larvae/plant), Azadirachtin 1500ppm(6.95 larvae/plant), Karanj oil 1% (7.10 larvae/plant), The highest mean larval population was observed in control plot (12.74 larvae/plant).

Keywords

Azadirachtin, Broccoli, Bio-pesticides, Efficacy, population

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Introduction

Broccoli (*Brassica oleracea* var. *italica*), belongs to family cruciferae, is a member of Cole group having 18 chromosomes (2n=18,

x=9). The term ‘Cole’ originated from the word Colewort meaning wild cabbage. While, the broccoli derived its name from the Latin word Brachium meaning an arm or branch (Dixon 2007). The species originated in

Mediterranean region. Area under cauliflower and broccoli is about 13 lakh hectare in the world with annual production of about 2 crore metric tons (Anonymous 2014). In India it is generally grown in hilly areas of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri Hills and Northern plains. In India cauliflower and broccoli are grown over an area of 4 lakh ha with annual production 85 lakh MT. Broccoli is known for its better taste, flavor and high nutritive and medicinal value. In the world market, about 40 per cent is marketed as fresh and remaining 60 per cent as frozen. It is used as curries, sauces, stir fried, boiled, steamed, soups, pickles and also eaten as a salad and cooked as a single or mixed vegetable with potato (Thamburaj and Singh 2001). Fresh broccoli contains 89.1 % water, 2500 IU vitamin A and 113 mg vitamin C per 100 g by weight (Dhaliwal 2012).

The pest complex is a major menace in cole crops production. Diamondback moth is a major pest of cruciferous vegetables crop like cabbage, cauliflower, broccoli, and rapeseed and enjoys worldwide distribution (Chelliah and Srinivasan, 1986). The DBM is a serious pest of crucifer vegetables throughout Asia (NRI, 1991; Zhang, 1994) and it is regular pest of cauliflower (Singh, 1980). In India, it was first recorded in 1914 on crucifer vegetable (Fletcher, 1914). Economic significance and remunerative nature of the cole crops in short span have compelled the growers to adopt intensive vegetable

cultivation. It has been estimated that the insect pests are responsible for reducing more than 40 percent yield in vegetables. Among these the DBM is the most devastating and cosmopolitan pests of crucifer vegetable (CIE, 1967).

The pest is found to be active from July to April with two peak periods, one during September when up to 38 percent are infested and the other during December to February when 23 to 37.9 percent cauliflower, 27 to 49 percent cabbage and 27 to 29 percent radish plant are infested (Chaudhary and Rawat, 1967). Diamond-back moth. *P. xylostella* (L.) is a major insect pest of crucifers vegetables (*Brassica* sp.) including cabbage, broccoli, cauliflower, kale, kohlrabi. Chinese cabbage and Brussels sprouts worldwide.

Materials and Methods

The experiment was laid out in a randomized block design (RBD) with 7 treatments (Table 1) and replicated three times. The plot size was 4 × 4 m² and the spacing 60cm × 45cm, on the of variety “Palam samridhi” used. All the recommended agronomic practices were adopted during the experimentation. The required quantity of spray solution was calibrated and spraying done by knapsack sprayer. The first spray of bio-insecticides was done at the initiation of pest infestation and second spray was done at 15 days after first spray.

Treatment details

Treatment	Name of bio-pesticides	Dose (g or ml /lit)
T ₁	<i>Bacillus thuringiensis</i> 2x10 ⁸	0.4 ml
T ₂	Azadirachtin (1500 ppm)	3 ml
T ₃	<i>Metarhizium anisopliae</i> 2.8x10 ⁶	2.5 ml
T ₄	NSKE 5%	5 ml
T ₅	Karanj oil 1%	10 ml
T ₆	Spinosad 45%SC	0.5 ml
T ₇	Control	-

Pretreatment observations were recorded from randomly selected 5 plants for each treatment. Post treatment observations were recorded at 1, 3, 7 and 15 days of each spray.

The yield of curds was recorded from each plot in each replication separately. The data obtained from the individual plant observations from RBD experiment was analyzed statistically as per the standard procedure.

Results and Discussion

Pre treatment observation before first spray

The larval population of diamond back moth was counted at randomly selected five plants. The pre treatment mean larval population showed in table 4.1 varied between 8.9 to 10.1 larvae /plant.

Observation after first day of first spray

The larval population recorded after one day of spraying indicated that the mean population of insect varied between 7.3to10.9 larvae/plant.

The lowest mean larval population was recorded in T6 (Spinosad 45% SC) *i.e.* 7.3 larvae/plant followed by NSKE 5% (7.6 larvae/plant), *Bacillus thuringiensis* 2×10^8 (8.1 larvae/plant), *Azadirachtin* 1500ppm (8.9 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 and Karanj oil 1% (9.1 larvae/plant). The maximum mean larval population was recorded in control plot (10.9 larvae/plant).

Observation after third day of first spray

The larval population recorded after third day of spraying indicated that the mean population of insect varied between 4.7to11.3 larvae/plant. The lowest mean larval

population was recorded in T6 (Spinosad 45% SC) *i.e.* 4.7 larvae/plant followed by *Metarhizium anisopliae* 2.8×10^6 (6.3 larvae/plant), Karanj oil 1% (6.6 larvae/plant), NSKE 5% (6.8 larvae/plant), *Bacillus thuringiensis* 2×10^8 (6.9 larvae/plant) and *Azadirachtin* 1500ppm (7.1 larvae/plant). The maximum mean larval population was recorded in control plot (11.3 larvae/plant).

Observation after seven day of first spray

The larval population recorded after seven day of spraying indicated that the mean population of insect varied between 3.1to12.1 larvae/plant.

The lowest mean larval population was recorded in T6 (Spinosad 45% SC) *i.e.* 3.1 larvae/plant followed by NSKE 5% (6.1 larvae/plant) and *Bacillus thuringiensis* 2×10^8 (6.1 larvae/plant), Karanj oil 1% (6.2 larvae/plant), *Azadirachtin* 1500ppm (6.5 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (6.9 larvae/plant). The maximum mean larval population was recorded in control plot (12.1 larvae/ plant).

Observation after fifteen day of first spray

The larval population recorded after fifteen day of spraying indicated that the mean population of insect varied between 1.9to12.3 larvae/plant.

The lowest mean larval population was recorded in T6 (Spinosad 45% SC) *i.e.* 1.9 larvae/plant followed by NSKE 5% (4.2 larvae/plant), Karanj oil 1% (4.4 larvae/plant), *Bacillus thuringiensis* 2×10^8 (5.0 larvae/plant), *Azadirachtin* 1500ppm (5.1 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (5.3 larvae/plant).

The maximum mean larval population was recorded in control plot (12.3 larvae/plant).

Table.1 Evaluation of biopesticides insecticides against broccoli diamond back moth during *Rabi* 2019-20

S.No.	Treatments	First spray					Second spray					Overall mean
		Pre Treat.	1DAS	3DAS	7DAS	15DAS	Pre Treat.	1DAS	3DAS	7DAS	15DAS	
1	<i>Bacillus thuringiensis</i> 0.4 ml	8.9 (3.15)*	8.1 (3.01)	6.9 (2.82)	6.1 (2.7)	5.0 (2.44)	8.3 (3.0)	8.3 (3.04)	5.7 (2.59)	5.1 (2.46)	5.0 (2.44)	6.73
2	<i>Azadirachtin</i> (1500ppm) 2.5 ml	9.7 (3.27)	8.9 (3.15)	7.1 (2.84)	6.5 (2.74)	5.1 (2.47)	6.5 (2.72)	8.6 (3.09)	6.3 (2.7)	6.0 (2.64)	4.7 (2.37)	6.95
3	<i>Metarhizium anisopliae</i> 2.5 ml	9.3 (3.21)	9.1 (3.18)	6.3 (2.69)	6.9 (2.8)	5.3 (2.5)	6.0 (2.64)	7.1 (2.85)	6.2 (2.67)	6.1 (2.67)	5.3 (2.51)	6.77
4	NSKE 5 ml	8.9 (3.14)	7.6 (2.93)	6.8 (2.79)	6.1 (2.67)	4.2 (2.27)	6.0 (2.62)	8.1 (3.01)	4.9 (2.43)	4.8 (2.4)	4.1 (2.24)	6.15
5	Karanj oil 1% 10 ml	10.1 (3.33)	9.1 (3.18)	6.6 (2.76)	6.2 (2.64)	4.4 (2.31)	7.5 (2.91)	8.7 (3.11)	6.6 (2.74)	6.7 (2.74)	5.1 (2.45)	7.10
6	Spinosad 45%SC 0.5 ml	9.9 (3.30)	7.3 (2.87)	4.7 (2.38)	3.1 (2.01)	1.9 (1.68)	4.9 (2.41)	4.4 (2.31)	4.2 (2.27)	3.3 (2.06)	1.9 (1.69)	4.54
7	Control	9.8 (3.29)	10.9 (3.45)	11.3 (3.50)	12.1 (3.61)	12.3 (3.64)	13.4 (3.78)	14.1 (3.87)	14.2 (3.88)	14.6 (3.93)	14.7 (3.95)	12.74
C.D. at 5%		N/A	0.239	0.143	0.42	0.251	0.473	0.416	0.38	0.439	0.229	-
SEm		0.088	0.077	0.046	0.135	0.08	0.152	0.134	0.122	0.141	0.074	-

* Figures in parenthesis are square root transformation

Table.2 Effect of biopesticides on yield parameters of broccoli var. “palam samridhi” during *Rabi*, 2019-20

Treatment	Dose (g or ml /lit.)	Yield (tonn./ha.)	Increased over control	Per cent increased
<i>Bacillus thuringiensis</i>	0.4 ml	21.60	4.23	24.35
<i>Azadirachtin</i> (1500ppm)	2.5 ml	19.03	1.66	9.55
<i>Metarhizium anisopliae</i>	2.5 ml	20.96	3.59	20.66
NSKE	5 ml	19.65	2.28	13.12
Karanj oil 1%	10 ml	18.49	1.12	6.44
Spinosad 45%SC	0.5 ml	23.27	5.9	33.97
Control	-	17.37	-	-

Fig.4.1 Mean larval population of diamond back moth after first spray

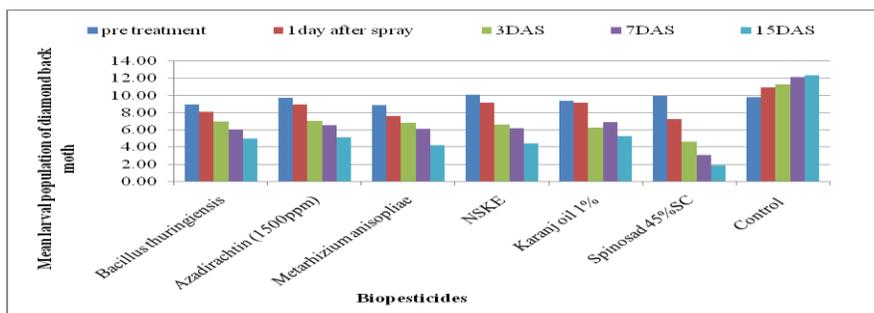
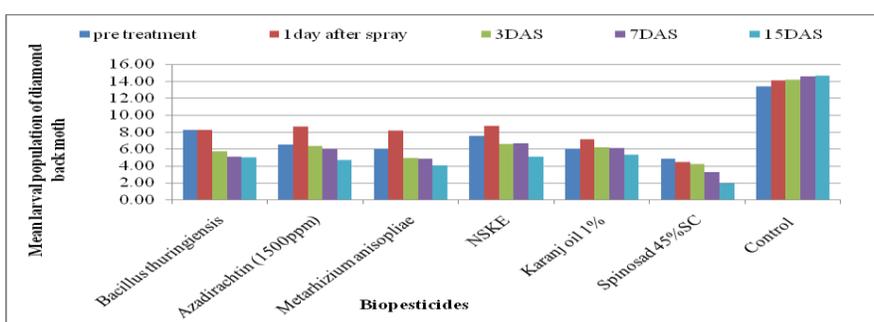


Fig.4.2 Mean larval population of diamond back moth after second spray



Observation after first day of second spray

The larval population recorded after first day of spraying indicated that the mean population of insect varied between 4.4 to 14.1 larvae/plant. The lowest mean larval population was recorded in T6 (Spinosad 45% SC) i.e. 4.4 larvae/plant followed by *Metarhizium anisopliae* 2.8×10^6 (7.1 larvae/plant), NSKE 5% (8.1 larvae/plant), *Bacillus thuringiensis* 2×10^8 (8.3 larvae/plant), *Azadirachtin* 1500ppm (8.6 larvae/plant), Karanj oil 1% (8.7 larvae/plant). The maximum mean larval population was recorded in control plot (14.1 larvae/plant).

Observation after third day of second spray

The larval population recorded after third day of spraying indicated that the mean population of insect varied between 4.2 to 14.2 larvae/plant. The lowest mean larval

population was recorded in T6 (Spinosad 45% SC) i.e. 4.2 larvae/plant followed by NSKE 5% (4.9 larvae/plant), *Bacillus thuringiensis* 2×10^8 (5.7 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (6.2 larvae/plant), *Azadirachtin* 1500ppm (6.3 larvae/plant), Karanj oil 1% (6.6 larvae/plant). The maximum mean larval population was recorded in control plot (14.2 larvae/plant).

Observation after seven day of second spray

The larval population recorded after seven day of spraying indicated that the mean population of insect varied between 3.3 to 14.6 larvae/plant. The lowest mean larval population was recorded in T6 (Spinosad 45% SC) i.e. 3.3 larvae/plant followed by NSKE 5% (4.8 larvae/plant), *Bacillus thuringiensis* 2×10^8 (5.1 larvae/plant), *Azadirachtin* 1500ppm (6.0 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (6.1 larvae/plant), Karanj

oil 1% (6.7 larvae/plant). The maximum mean larval population was recorded in control plot (14.6 larvae/plant).

Observation after fifteen day of second spray

The larval population recorded after fifteen day of spraying indicated that the mean population of insect varied between 1.9 to 14.7 larvae/plant. The lowest mean larval population was recorded in T6 (Spinosad 45% SC) *i.e.* 1.9 larvae/plant followed by NSKE 5% (4.1 larvae/plant), *Azadirachtin* 1500ppm (4.7 larvae/plant), *Bacillus thuringiensis* 2×10^8 (5.0 larvae/plant), Karanj oil 1% (5.1 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (5.3 larvae/plant), The maximum mean larval population was recorded in control plot (14.7 larvae/plant).

Overall mean population after first and second spray

The overall mean larval population recorded after first and second spray revealed that T6 (Spinosad 45% SC) found best treatment in respect to other treatments because it's recorded lowest mean larval population *i.e.* 4.54 larvae/plant followed by NSKE 5% (6.15 larvae/plant), *Bacillus thuringiensis* 2×10^8 (6.73 larvae/plant), *Metarhizium anisopliae* 2.8×10^6 (6.77 larvae/plant), *Azadirachtin* 1500ppm (6.95 larvae/plant), Karanj oil 1% (7.10 larvae/plant), The maximum mean larval population was recorded in control plot (12.74 larvae/plant).

The present findings are agreement with the findings of Debbarma *et al.*, (2017) conduct a field trial to evaluate the efficacy of certain bio-rational insecticides against *Plutella xylostella* and *Pieris brassicae* on a crop variety "Pride of India". The studied revealed that Spinosad (*Saccharopolyspora spinosa*) 2.5 SC @ 500 ml /ha was found most

effective to control both these pests with lower mean leaf damage by 14.22 percent and 24.30 percent respectively. It was followed by myco-jaal (*Beauveria bassiana*) 10 SC @ 500 ml /ha with 15.11 percent and 26.59 percent and differs significantly from untreated control 69.18 percent. The present findings are also agreement with the findings of Meena and Singh., (2003) reported that spinosad 45 SC @ 0.002 percent proved to be the most effective insecticide in reducing the larval population of *P. xylostella* among all the tested insecticides and recorded highest yield of 233.50 q /ha.

In conclusion the overall mean larval population recorded after first and second spray revealed that T6 (Spinosad 45% SC 0.5ml) found best treatment in respect to other treatments because its recorded lowest mean larval population *i.e.* 4.54 larvae/plant followed by NSKE 5ml (6.15 larvae/plant), *Bacillus thuringiensis* 0.4 ml (6.73 larvae/plant), *Metarhizium anisopliae* 2.5 ml (6.77 larvae/plant), *Azadirachtin* (1500ppm) 2.5 ml (6.95 larvae/plant), Karanj oil 1% 10 ml (7.10 larvae/plant), The maximum mean larval population was recorded in control plot (12.74 larvae/plant).

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