Environment and Ecology 42 (4) : 1504—1509, October—December 2024
Article DOI: https://doi.org/10.60151/envec/LSCG3609
ISSN 0970-0420

Efficacy of Certain Bio-Pesticides against the Major Insect Pests of Broccoli (*Brassica oleracea* var. *italica* L.)

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Received 25 April 2024, Accepted 13 August 2024, Published on 18 October 2024

ABSTRACT

The field experiment was undertaken at the Experimental Farm, Department of Entomology, School of Agricultural Sciences (SAS), Medziphema Campus, Nagaland University, during the period of November 2021 to February 2022 to study the efficacy of certain bio-pesticides against major insect pests of broccoli. The experiment was conducted using Randomized Block Design (RBD) with six treatments including control and replicated four times. The study revealed that Indian cabbage white, *Pieris* spp. and green peach aphid, *Myzus persicae* have been found to be the major insect pest in broccoli. It is recorded that the highest (73.49%) population reduction of *M. persicae* was obtained from the plot treated with emamectin benzoate 5% SG and the highest (90.16%) population reduction of *Pieris* spp. was recorded on the plot treated with spinosad 45% SG. Therefore, the study concluded that use of bio-pesticides offers a great efficacy in controlling the pest and diminish the pesticides related issue.

Keywords Broccoli, Insect pest, Bio-pesticides, *Pieris* spp., *Myzus persicae.*

INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica* L.) is a significant and profoundly nutritive outlandish vegetable under the family Brassicaceae (Sheokand *et al.* 2018). Broccoli is a cool season vegetable which flourishes excellent in cool and moist climate. It is utilized as in sauces, sautéed, steamed, curries soups, pickles, bubbled and furthermore eaten as a serving of mixed greens and cooked as a solitary or blended vegetable in with potato (Thamburaj and Sing 2001). The pest which attack the broccoli are cabbage butterfly, *Pieris brassicae*, leaf webber, *Crocidolomia binotalis*, leaf eating weevil, *Tanymecus circumdatus*, cut worm, *Agrotis ipsilon*, termite, *Microtermes obesi*, cabbage head borer, *Hellula undalis*; mustard saw fly, *Athalia lugens proxima*; painted bug, *Bagrada cruciferarum*, aphids, *Brevicoryne brassicae* and *Lipaphis erysimi*,

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diamond back moth, *Plutella xylostela*, white fly, *Bemesia tabaci*; leaf miner, *Chromatomyia horticola,* tobacco caterpillar, *Spodoptera litura*, red spider mite, *Tetranychus urticae* (Anonymous 2014).

As of now, the management of pest is essentially reliant upon the utilization of various pesticides of engineered beginning, for example, carbamates, organochlorines, neonicotinoids, pyrethroids and organophosphates. Their unregulated and aimless use has affected the non-target organic entities unfavorably which result lead to resistance to pesticides and outbreak of secondary insect pests, and additional has risked human as well as ecological wellbeing (Tudi *et al.* 2021). Frequently, toxic combinations have explicit targets; various blends show general destructiveness. In such instances the plants need to protect themselves. Inside the vegetation deliver of artificial guarded compounds terpenoids, alkaloids phenolic compounds and numerous polypeptides can be found.

Plants contain a rich wellspring of bioactive mixtures (Loi *et al.* 2020). Some of that have advanced to safeguard them from attack via pest, different herbivores and microorganisms (War *et al.* 2012). Bioactive mixtures can move approximately as poisons, chemosterilants, anti-dealers, taking care of impediments/opposed to feedants, improvement retardants, as well as attractants (Khater 2012, Mithofer and Maffei 2016). Elements of these combos have displayed great insecticidal capacity in opposition to insects (Sahayaraj and Kalidas 2011). Bio-pesticide has greater unique pests goal than a chemical pesticide, thus for that reason it reduces the threat of different organisms, consisting of mammals and bird (Thakore 2006).

MATERIALS AND METHODS

The experiment was carried out at the Experimental Farm of Department of Entomology, SAS, Nagaland University, Medziphema. It is situated at 23°45'53''N latitude and 93°52'04''E longitude and has the elevation of 310 m above mean sea level. The experimental farm falls under sub tropical type of climate with an average rainfall ranging from 2000- 2500 mm annually. The experiment was conducted using Randomized Block Design (RBD) with six treatments including control and replicated four times. There were two spray schedules. First spray was initiated after the appearance of the insect pest population and the second application was carried out after 15 days intervals. The insect pest population were recorded one day before application of treatment and subsequently at 3, 5, 7 and 9 days after each spray schedule to study the efficacy of the different treatments.

Thus, the per cent reduction on the pest population was calculated with the help of following formula.

$$\% \text{ reduction} = \frac{\text{Pre treatment count} - \text{Post treatment count}}{\text{Pre treatment count}} \times 100$$

RESULTS AND DISCUSSION

Efficacy of bio-pesticides against Indian cabbage white, *Pieris* spp.

After first spray

The data presented in Table 1 reveals that one day prior of the first spray, the mean population of *Pieris* spp. ranges from 7.65 to 8.30 per plant. The maximum reduction of *Pieris* spp. after three days was observed in spinosad 45 % SC (84.57%) followed by emamectin benzoate 5% SG (82.36%), multineem oil (62.57%) and garlic, chilli and ginger extract (55.70 %). Tobacco leaf extract (50.60%) was found to be the least effective among all the treatments. After 5 days of spraying the maximum reduction of *Pieris* spp. larva was found in spinosad (90.36%) followed by emamectin benzoate 5 % SG (88.64 %), multineem oil (70.53%) and garlic, chilli and ginger extract (60.58%). Tobacco leaf extract (56.62%) was found to be the least effective among all the treatment. The computed data on reduction in *Pieris* spp. larvae after 7 days of spraying was found to be highest in spinosad 45% SC (95.15%) followed by emamectin benzoate 5% SG (92.53%) with no significant difference between them. Tobacco leaf extract (63.85%) was found to be the least effective among all the treatments. After 9 days of spraying also the maximum reduction of *Pieris* spp. larva was found in spinosad (87.87%) fol-

Table 1. Effect of different bio-pesticides against Indian cabbage white, *Pieris* spp. on broccoli during November 2021 to February 2022.

Treatments	First spray					Second spray					
	Pre-treatment count (No. per plant)	Per cent reduction				Pre-treatment count (No. per plant)	Per cent reduction				
		3 DAS	5 DAS	7 DAS	9 DAS		3 DAS	5 DAS	7 DAS	9 DAS	Mean
Ginger + Garlic + Chilli extract: (T_1)	8.00	55.70 (48.30)	60.56 (51.16)	67.58 (55.36)	62.36 (52.20)	6.25	57.95 (49.60)	62.40 (52.20)	67.95 (55.60)	65.56 (54.09)	**62.51**
Multineem oil: (T_2)	8.10	62.57 (52.35)	70.53 (57.25)	74.34 (59.73)	67.01 (54.98)	6.10	64.80 (53.68)	70.58 (57.20)	75.60 (60.56)	66.35 (54.63)	**68.97**
Spinosad: (T_3)	8.25	84.57 (66.88)	90.36 (71.91)	95.15 (77.27)	87.87 (69.62)	5.95	85.72 (67.80)	92.47 (74.33)	96.65 (79.62)	88.45 (70.23)	**90.16**
Tobacco leaf extract: (T_4)	8.30	50.60 (45.34)	56.62 (48.80)	63.85 (53.04)	58.88 (50.12)	6.20	50.40 (45.23)	57.66 (49.41)	62.50 (52.24)	58.87 (50.15)	**57.42**
Emamectin benzoate: (T_5)	7.65	82.36 (65.31)	88.64 (70.36)	92.53 (74.25)	84.42 (66.88)	6.25	80.73 (63.97)	85.55 (67.66)	92.78 (74.44)	87.72 (69.50)	**86.84**
Untreated control: (T_6)	7.95	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	6.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	**0.00**
SEm±	**0.36**	**2.67**	**2.37**	**2.16**	**1.80**	**0.13**	**1.78**	**1.38**	**1.78**	**1.87**	-
CD (p=0.05)	**NS**	**8.05**	**7.13**	**6.52**	**5.44**	**NS**	**5.36**	**4.17**	**5.35**	**5.65**	-

Note: Figures in the table are mean values and those in parenthesis are angular transformed values.
NS: Non significant at 5% level of significance.

lowed by emamectin benzoate 5 % SG (84.42%) with no significant difference between them. Tobacco leaf extract (58.88 %) was found to be the least effective among all the treatments followed by garlic, chilli and ginger extract (62.36%) which were at par with each other as shown in Fig. 1.

After second spray

Table 1 indicates the mean larval population of *Pieris* spp. one day before 2nd spray ranged from 5.95 – 6.25 per plant. After 3 days of spraying, the reduction of *Pieris* spp. larvae was observed highest (85.72%) in the plot treated with spinosad 45% SC followed by emamectin benzoate 5% SG (80.73%), multineem oil (64.80%) and garlic, chilli and ginger extract (57.95%), while the lowest reduction was found on the plot treated with tobacco leaf extract (50.40%). The reduction of *Pieris* spp. after five days shows that the maximum reduction was found in spinosad

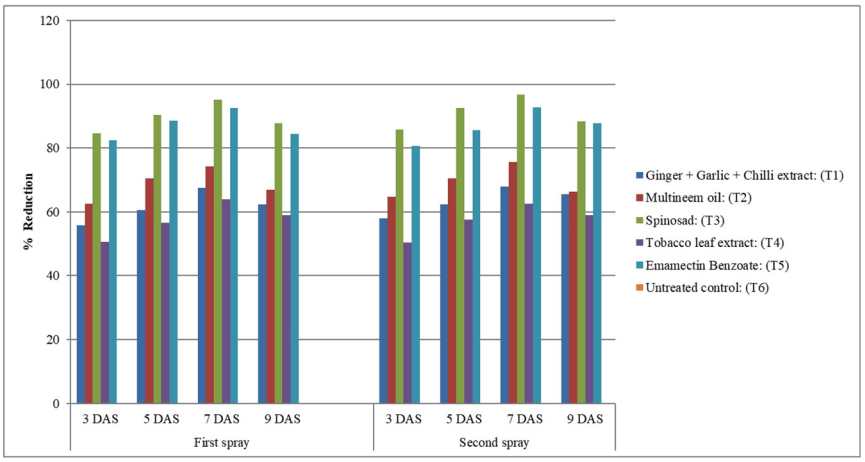

Fig. 1. Effect of different bio-pesticides against cabbage butterfly, *Pieris* spp. on broccoli during November 2021 to February 2022.

45% SC (92.47%) followed by emamectin benzoate 5% SG (85.55%) and the least efficacy was found in tobacco leaf extract (57.66%). The computed data on larval population of *Pieris* spp. after 7 days of spraying shows that the highest reduction was found in the plot treated with spinosad 45% SC (96.65%) followed by emamectin benzoate (92.78%) with no significant difference between them. Multineem oil, garlic, chilli and ginger extract and tobacco leaf extract was also found effective reducing larval population by 75.60, 67.95 and 62.50%, respectively. The larval population of *Pieris* spp. after nine days of spraying also shows that tobacco leaf extract was the least effective with 58.87 % reduction, while the highest reduction was recorded on spinosad 45% SC (88.45%) which was at par with emamectin benzoate 5% SG (87.72%). Multineem oil and garlic, chilli and ginger extract was found equally effective exhibiting 66.35 and 65.56% reduction, respectively (Fig. 1).

The results obtained after 1st and 2nd spray on broccoli against larval population of *Pieris* spp. shows that (Table 1 and Fig. 1) the highest mean reduction was obtained on Spinosad 45% SC with 90.16% followed by emamectin benzoate with 86.84%. The lowest mean reduction was recorded on the plot treated with tobacco leaf extract with 57.42%. Decrease in the reduction percentage of Indian cabbage white after 7 DAS was due to lowering down of the toxic principles of the biopesticides. The present findings are in conformity with the findings of Neog (2020) who reported that spinosad 45 % SC gives the highest reduction of cabbage butterfly population by 82.70 to 89.94%. Similarly, Mane *et al.* (2020) and Bhandari *et al.* (2019) also reported that cabbage butterfly can be controlled effectively by using Spinosad 45% SC.

Efficacy of bio-pesticides against green peach aphid, *Myzus persicae*

After first spray

From the Table 2 it is shown that one day prior to the application of 1st spray, the mean number of *Myzus persicae* population ranges from 43.73 to 51.00 per leaf. The reduction on *M. persicae* after three days of spraying shows that, emamectin benzoate 5% SG recorded the highest reduction (62.28 %) followed by spinosad 45% SC (58.87%), multineem oil (55.53 %), garlic, chilli and ginger extract (52.51 %). The plots treated with tobacco leaf extract (40.68 %) gives the least reduction. After five days of spraying, the highest reduction (72.47%) was observed on the plot treated with emamectin benzoate 5% SG followed

Table 2. Effect of different bio-pesticides against green peach aphid, *Myzus persicae* on broccoli during November 2021 to February 2022.

Treatments	First spray					Second spray					
	Pre-treatment count (No. per plant)	Per cent reduction 3 DAS	5 DAS	7 DAS	9 DAS	Pre-treatment count (No. per plant)	Per cent reduction 3 DAS	5 DAS	7 DAS	9 DAS	Mean
Ginger + Garlic + Chilli extract: (T_1)	51.00	52.51 (46.44)	60.35 (51.01)	64.52 (53.57)	55.36 (48.08)	38.11	55.64 (48.26)	62.14 (52.16)	68.26 (55.85)	60.37 (51.03)	**59.89**
Multineem oil: (T_2)	44.46	55.53 (48.18)	67.44 (55.23)	72.00 (58.06)	64.55 (53.48)	36.67	57.18 (49.15)	70.96 (57.39)	75.67 (60.45)	67.80 (55.46)	**66.39**
Spinosad: (T_3)	44.45	58.87 (50.11)	70.67 (57.21)	77.50 (61.68)	68.79 (56.06)	36.26	60.34 (50.99)	74.97 (59.99)	80.48 (63.81)	72.28 (58.24)	**70.49**
Tobacco leaf extract: (T_4)	50.48	40.68 (39.62)	50.70 (45.40)	57.12 (49.11)	52.36 (46.36)	36.70	44.16 (41.61)	52.34 (46.34)	60.46 (51.06)	54.40 (47.53)	**51.53**
Emamectin benzoate: (T_5)	43.73	62.28 (52.12)	72.47 (58.37)	80.46 (63.80)	74.70 (59.83)	34.21	65.68 (54.16)	74.45 (59.68)	82.55 (65.32)	75.35 (60.25)	**73.49**
Untreated control: (T_6)	51.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	38.65	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	**0.00**
SEm±	**2.16**	**1.71**	**1.99**	**2.22**	**1.94**	**0.69**	**3.00**	**2.67**	**1.91**	**2.13**	-
CD (p=0.05)	**NS**	**5.16**	**6.00**	**6.71**	**5.85**	**NS**	**9.05**	**8.05**	**5.76**	**6.41**	-

Note: Figures in the table are mean values and those in parenthesis are angular transformed values.
NS: Non significant at 5% level of significance.

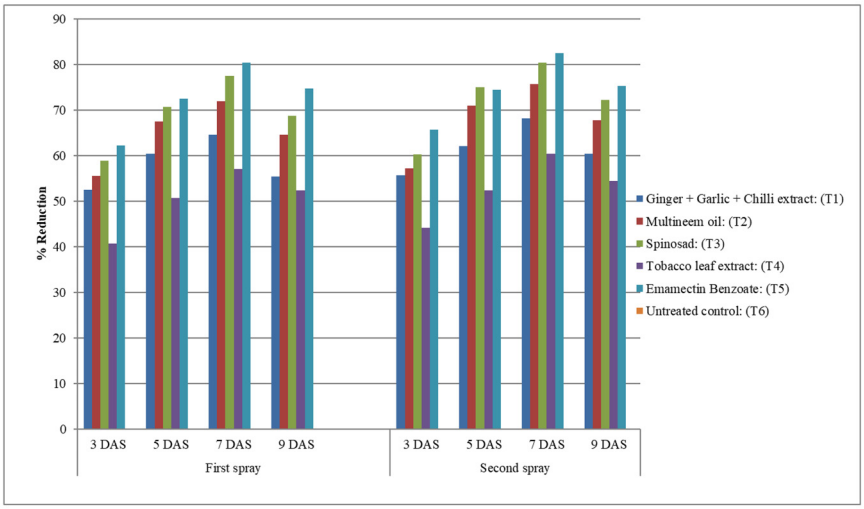

Fig. 2. Effect of different bio-pesticides against green peach aphid, *Myzus persicae* on broccoli during November 2021 to February 2022 .

by spinosad 45 % SC (70.67%) and multineem oil (67.44 %) which were statistically at par with each other. The treatment tobacco leaf extract exhibited the lowest (50.70 %) reduction of green peach aphid population followed by garlic, chilli and ginger extract (60.35 %). The computed data on percent reduction in *M. persicae* after seven days of spraying revealed that maximum reduction (80.46%) was observed in emamectin benzoate 5% SG followed by spinosad 45 % SC (77.50 %), multineem oil (72.00%) and garlic, chilli and ginger extract (64.52%). The treatment tobacco leaf extract gave the least reduction (57.12 %). After nine days of treatment also, the highest reduction (74.70 %) of *M. persicae* was observed on the plot treated with emamectin benzoate 5 % SG. It was followed by spinosad 45 % SG (68.79 %), multineem oil (64.55 %) and garlic, chilli and ginger extract (55.36 %). The lowest reduction (52.36 %) of *M. persicae* was found in the plot treated with tobacco leaf extract (Fig. 2).

After second spray

Table 2 depicts the population of *M. persicae* one day before 2nd spraying ranges from 34.21 to 38.65 per leaf. After 3 days of spraying, the highest reduction (65.68%) of *M. persicae* was observed in the plot treated with emamectin benzoate 5% SG followed by spinosad 45 % SC (60.34%) and multineem oil (57.18%) with no significant difference among them. The lowest reduction was found on the plot treated with tobacco leaf extract with 44.16%. The percent reduction of *M. persicae* after five days shows that the maximum reduction was found in spinosad 45 % SC (74.97 %) which was at par with emamectin benzoate 5% SG (74.45 %) and multineem oil (70.96 %). Tobacco leaf extract gives the least (52.34 %) reduction of *M. persicae* population followed by garlic, chilli and ginger extract (62.14 %). The data on reduction of *M. persicae* after 7 days of spraying shows that the highest reduction was found in the plot treated with emamectin benzoate (82.55%) followed by spinosad 45% SC (80.48%), multineem oil (75.67 %) and garlic, chilli and ginger extract (68.26 %). The lowest reduction was found on the plot treated with tobacco leaf extract (60.46%). Similarly, after nine days of spraying also tobacco leaf extract exhibited the least (54.40%) effective treatments. Highest reduction was recorded on emamectin benzoate 5% SG (75.35 %) which was at par with spinosad 45% SC (72.28 %). Multineem oil and garlic, chilli and ginger extract was also found more or less effective exhibiting 67.80 and 60.37 % reduction, respectively (Fig. 2).

The results obtained after 1st and 2nd spray on broccoli against *M. persicae* shows that (Table 2 and

Fig. 2) the highest mean reduction was observed on emamectin benzoate (73.49 %) followed by spinosad 45% SC (70.49%), multineem oil (66.39%) and garlic, chilli and ginger extract (59.89 %). The lowest mean reduction was recorded on the plot treated with tobacco leaf extract (51.53%). Decrease in the reduction percentage of green peach aphids after 7 DAS was due to lowering down of the toxic principles of the biopesticides. Yadav *et al.* (2018) also reported that emamectin benzoate gave the highest population reduction of mustard aphid with 36.83, 72.09 and 98.42% at 3,7 and 10 days after spraying, respectively. Similarly, Dotasara *et al.* (2017) also reported emamectin benzoate to be superior over control in controlling the mustard aphids.

CONCLUSION

The current study shows that use of bio-pesticides offers a great efficacy in controlling the pest, which offers desire for the farmer to control the pest economically and without causing the environment. It is notable that continuous utilization of synthetic pesticides against the insect pests is harmful to human being and climate. The treatment emamectin benzoate 5% SG gives a good result in reducing the population of *Myzus persicae* as it penetrates the leaf tissues and forms a reservoir within the leaf. Bio-pesticides spinosad 45% SC is highly effective and compatible against major insect pests especially lepidopteran pests. It degrades easily in the environment and posses less risk on beneficial organism. Hence, significance ought to be given on picking of appropriate treatments with perfect timing in legitimate measurements applications methods to diminish the pesticides related issue.

ACKNOWLEDGMENT

The authors are grateful to School of Agricultural Sciences (SAS), Nagaland University, Medziphema 797106, Nagaland, India, for their invaluable assistance and providing the necessary facilities for carrying out this research.

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