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RESEARCH NOTE

Efficacy of biopesticides against sucking insect pests of chilli (*Capsicum annuum* L.) and their impact on fruit yield

N. AJITH [1*], WALUNIBA[1], PANKAJ NEOG[1], SUSANTA BANIK[2] and SENTIRENLA JAMIR[3]

[1]Department of Entomology, [2]Department of Plant Pathology, [3]Department of Horticulture
School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, India
[*]**E-mail:** ajith.ento@gmail.com

ABSTRACT: Efficacy of different biopesicides was evaluated against major sucking insect pests of chilli (*Capsicum annuum* L.) under foot hills of Nagaland, India during November to May 2021-22. The overall average per cent reduction of sucking insect pest population indicated that Spinosad 45% SC (67.07%) was proved to be significantly superior to control followed by Neem seed powder pellet formulation (52.14%). Among Entomopathogenic fungi *Lecanicillium lecanii* (44.46%) was the most effective followed by *Beauveria bassiana* (42.91%) and *Metarhizium anisopliae* (40.84%). Pongamia oil (32.92%) was found to be the least effective among all the treatments. Spinosad 45% SC was found to have high cost benefit ratio (1:1.82) followed by *Lecanicillium lecanii* (1:1.75), *Beauveria bassiana* (1:1.62), Neem seed powder pellet formulation (1:1.47), *Metarhizium anisopliae* (1:1.44) and Pongamia oil (1:0.99). To ensure healthy and sustainable food production, use of chemical insecticides should be reduced and there is an increasing need to utilize biopesticides available and to develop new biopesticides with different mode of action.

Keywords: Biopesticides, Chilli, Efficacy, Entomopathogens, Sucking Pests

In India, Chilli (*Capsicum annuum* L.) is a well-known spice and vegetable crop extensively cultivated in tropical and sub-tropical regions throughout the year. Chilli is commercially cultivated for its pungent fruits. Capsaicin, the active ingredient of spice possesses several medicinal properties like antioxidant, anti-mutagenic and anti-carcinogenic effects with the ability to boost immune system (Saxena *et al.,* 2016). Chilli is infested by various insect pests from the time of planting to post harvest. Among 39 genera and 51 species of insects and mites infesting chilli crop (Kumar *et al.,* 2020), thrips (*Scirtothrips dorsalis* Hood), aphids (*Aphis gossypii* Glover) and whiteflies (*Bemisia tabaci* Genn) are the most important sucking pests which has a negative impact on chilli production. They are extremely polyphagous in nature and feed by sucking sap from leaves, tender shoots, flower buds and fruits. These pests have vast host range and short life cycle which make them difficult to manage. Kandasamy *et al.,* 1990 indicated that the yield loss due to insect pests of chilli range from 50-90 per cent.

Non-chemical insect pest management is an environmentally conscious approach to manage insect pests. It contributes to the sustainability of agricultural output and also minimizes crop production costs. In the past few decades, non-target organisms and the environment has been affected perniciously by the injudicious use of insecticides. The best suitable alternate is use of natural products such as botanicals and bio-agents. This suggests that developing an efficient non-chemical insect pest management ensures healthy food production.

The experiment was conducted in the experimental farm, Department of Entomology, School of Agricultural Sciences and Rural Development, Nagaland, India during November to May 2021-22 in randomized block design with eight treatments and each replicated thrice. The treatments are two botanical pesticides Neem seed powder pellet formulation (NSPPF) (30 g L^{-1}) and Pongamia oil (2 mL L^{-1}) and four microbial pesticides namely *Lecanicillium lecanii* (5 g L^{-1}), *Metarhizium anisopliae* (4 g L^{-1}), *Beauveria bassiana* (5 g L^{-1}) and Spinosad 45% SC (0.25 mL L^{-1}) along with Imidacloprid 17.8% SL (0.4 mL L^{-1}) as chemical check and untreated control. The seedlings of chilli variety KSP-1347 NIRMITI were transplanted to the experimental plots of 3.5 m × 2.0 m by adopting the spacing of 60 cm × 45 cm. Two sprays were given at 85, 110 days after transplantation. Before and after the biopesticides spray, population of sucking pests was taken on five randomly selected plants from each plot at three, five and seven days after treatments. The population of sucking pests

Table 1. Effect of different biopesticides on sucking pests of chilli

Treatments	Mean no. of thrips/ three leaves			Average % Reduction	Mean no. of aphids/ three leaves			Average % Reduction	Mean no. of whitefly/ three leaves			Average % Reduction	Overall Average % Reduction
	First spray	Second spray	Mean		First spray	Second spray	Mean		First spray	Second spray	Mean		
Neem seed powder pellet formulation (NSPPF)	6.96	6.69	6.83	49.58	8.01	7.86	7.93	53.05	4.13	4.62	4.38	53.78	52.14
Pongamia oil	10.13	9.96	10.05	32.73	12.58	12.69	12.64	32.68	7.11	7.87	7.49	33.36	32.92
Lecanicillium lecani	8.44	8.11	8.28	42.25	10.04	9.88	9.96	45.35	5.67	5.75	5.71	45.78	44.46
Metarhizium anisopliae	8.69	8.40	8.55	39.54	10.78	10.58	10.68	41.55	6.27	6.11	6.19	41.43	40.84
Beauveria bassiana	8.46	8.38	8.42	41.11	10.29	10.40	10.35	43.68	6.09	5.98	6.03	43.96	42.91
Spinosad 45% SC	4.60	4.56	4.58	63.95	5.13	5.49	5.31	67.32	2.55	2.73	2.64	69.93	67.07
Imidacloprid 17.8% SL	3.93	3.78	3.86	69.72	4.67	4.89	4.78	72.75	2.11	2.34	2.23	74.18	72.22
Control	14.22	14.18	14.20	0.00	17.80	18.47	18.14	0.00	11.16	11.13	11.14	0.00	0.00
C.D. (P=0.05)	0.31	0.48	-	-	0.32	0.45	-	-	0.39	0.42	-	-	-
SE(m)±	0.10	0.16	-	-	0.11	0.15	-	-	0.13	0.14	-	-	-

viz., thrips, aphids and whiteflies was counted on three leaves per plant from upper, middle and lower positions during morning hours as per the method suggested by Satpathy (1973) by using 10X magnifying lens. Matured chilli fruits were harvested and weighed to get yield data. Then the data were subjected to statistical analysis of variance (ANOVA).

Efficacy of different biopesticides was evaluated at three, five and seven days after spraying against sucking pests namely thrips, aphids and whiteflies. From the present findings, it is evident that all the treatments were statistically superior to control. The overall average per cent reduction of sucking pests (Table 1) indicated that Spinosad 45% SC was proved to be significantly superior in controlling sucking pests population with the per cent reduction of 67.07%. Neem seed powder pellet formulation (NSPPF) was moderately effective against sucking pests with the per cent reduction of 52.14%. Among Entomopathogenic fungi *Lecanicillium lecanii* (44.46%) was the most effective followed by *Beauveria bassiana* (42.91%) and *Metarhizium anisopliae* (40.84%). Pongamia oil (32.92%) was found to be the least effective among all the treatments. The chemical check Imidacloprid 17.8% SL recorded the maximum per cent reduction of 72.22 per cent.

Entomopathogenic fungi (EPF) are reported to control the pest populations by the release of spores and mycotoxins such as Beauvericin, Beauverolides and Destruxins (Gabarty *et al.,* 2014). Study of Samota *et al.* (2017) is in close proximity with the present results, who found that Spinosad and NSKE were moderately effective against thrips, followed by *B. bassiana* (34.86%) and *M. anisopliae* (33.60%) both are at par with each other. Borkakati *et al.,* (2019) revealed that the population of *Aphis gossypii*, *Scirtothrips dorsalis* and *Bemisia tabaci* were significantly reduced by Imidacloprid 17.8% SL closely followed by *Beauveria bassiana*. Harshita *et al.,* (2019) indicated that spinosad @ 0.3 mL L^{-1} was graded as the most effective treatment followed by azadirachtin @ 5 mL L^{-1} and *B. bassiana* @ 5 mL L^{-1} in reducing whitefly population. Singh and Kaur (2020) reported that EPF are the most efficient in suppressing aphid and whitefly populations on vegetable crops. Nimbalkar *et al.,* (2022) found that Neem oil @ 5 mL L^{-1} was proved very effective in management of thrips and whiteflies followed by NSKE 5%, *Verticilium lecanii* @ 4 g L^{-1} and *Metarrhizium anisopliae* @ 4 g L^{-1} respectively.

The fruit yield obtained from various treatments were statistically analyzed and presented in Table 1. All the biopesticides produced comparatively higher yield than untreated control (30.1 q ha^{-1}). Among the biopesticides, spinosad 45% SC (53.7 q ha^{-1}) recorded the highest yield followed by Neem seed powder pellet formulation (50.5 q ha^{-1}), *L. lecanii* (49.2 q ha^{-1}), *Beauveria bassiana* (46.9 q ha^{-1}), *Metarhizium anisopliae* (43.4 q ha^{-1}) and Pongamia oil (35.3 q ha^{-1}). Spinosad 45% SC was found to have high benefit cost ratio (1.82) followed by *Lecanicillium lecanii* (1.75), *Beauveria bassiana* (1.62), Neem seed powder pellet formulation (1.47), *Metarhizium anisopliae* (1.44) and Pongamia oil (0.99). The yield and cost benefit ratio of biopesticides treatment does not differ much than the chemical check, Imidacloprid 17.8% SL (56.4 q ha^{-1} and 1:2.20). Foliar spray of microbial pesticides were resulted in population reduction of sucking pests below economic injury level and had positive effects on yield compared to botanical pesticides. EPF present on rhizosphere region influences nitrogen availability thus promotes plant growth (Behie and Bidochka 2014). To ensure healthy food production, use of chemical insecticides should be reduced and there is an increasing need to utilize biopesticides available and to develop new products with different modes of action.

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