



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2025): 4.97
IJAFA 2025; 7(10): 406-408
www.agriculturaljournals.com
Received: 20-08-2025
Accepted: 22-09-2025

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Evaluation of bio-pesticides against ladybird beetle, *Coccinella transversalis* (Fabricius) in high density planting (HDP) of *Bt* cotton.

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DOI: <https://www.doi.org/10.33545/2664844X.2025.v7.i10f.902>

Abstract

The present study entitled “Evaluation of bio-pesticides against ladybird beetle, *Coccinella transversalis* (Fabricius) in high density planting (HDP) of *Bt* cotton” was undertaken at Agricultural farm of College of Agriculture, Dhule (Maharashtra)- 424004 during *Kharif*-2023. The experiment was designed using a Randomized Block Design, incorporating eight treatments and three replications. The variety selected for this study was “RCH-659 BG II”. A total of eight treatments were used in the current investigation, which included *Lecanicillium lecanii* 1.15% WP @ 2500g ha⁻¹, *Metarhizium anisopliae* 1.15% WP @ 2500g ha⁻¹, *Beauveria bassiana* 1.15% WP @ 2500g ha⁻¹, *Lecanicillium lecanii* 1.15% WP @ 5000g ha⁻¹, *Metarhizium anisopliae* 1.15% WP @ 5000g ha⁻¹, *Beauveria bassiana* 1.15% WP @ 5000g ha⁻¹, Neem oil 10000 ppm @ 1000ml ha⁻¹ and untreated Control. Regarding the effectiveness of the all of them demonstrated a little impact on the population of *Coccinellids*. and *L. lecanii* 1.15% WP @ 2500g ha⁻¹ was recorded the highest population of beetles and proved safer as compared to other biopesticides.

Keywords: ladybird beetle, *coccinellids*, *Bt* cotton, biopesticides

Introduction

Cotton (*Gossypium Spp.*), often referred to as “White gold” in India, belongs to the *Malvaceae* family and the *Gossypium* genus. With approximately 40 species of cotton, among these only four are cultivated: *Gossypium arboreum*, *G. herbaceum*, *G. hirsutum*, and *G. barbadense*. It is the most widely grown and profitable non-food crop worldwide. India's cotton-growing regions are categorized into three zones: the North zone (Punjab, Haryana, and Rajasthan), the Central zone (MP, MH, and GJ), and the South zone (AP, TN, KA, and TN). Additionally, cotton cultivation is gaining traction in the Eastern state of Odisha and in smaller areas of non-traditional states like UP, WB, and Tripura. (Anonymous, 2024) ^[1]. In 2023-24, cotton cultivation in India shrank to roughly 126.80 L hectares, down from 129.27 L hectares in 2022-23 and production fell to approximately 325.22 L bales, compared to 336.60 lakh bales in 2022-23. (MA&FW, 2024) ^[5]. The primary insect pests in India include sucking pests such as Aphids, Jassids, Whiteflies, and Thrips, as well as bollworms like the American bollworm, Spotted bollworm, and pink bollworm (Bhamare and Wadnerkar, 2018) ^[2]. They have been known to cause losses in cotton production ranging from 11.60 per cent to 44.50 per cent, with the potential to decrease yields by 20 per cent to 80 per cent (Thakare *et al.*, 1983) ^[8]. Among these sucking pests, the aphid is a significant one that is naturally controlled by the ladybird beetle (Saner *et al.*, 2014) ^[7]. The ladybird beetle, *Coccinella transversalis* (Fabricius) is recognized as the most effective and promising predator of cotton pests. Both the grub and adult stages of the ladybird beetles feed voraciously on cotton pests such as aphids, jassids, and whiteflies, significantly reducing their populations. Therefore, it is necessary to manage the pests effectively.

Material and Methods

The field experiment was conducted during *Kharif*-2023 at Agricultural Farm of Entomology Section, College of Agriculture, Dhule, Maharashtra, India-424004.

Eight treatments including untreated control were replicated thrice in randomized block design. *Bt* cotton hybrid “RCH-659 BG II” variety was sown in 3.65m × 3.04m plots at row and plant spacing of 120cm × 30cm. Pre-treatment counts (PTC) were recorded one day before the spray, and observations for ladybird beetles on *Bt* cotton were made on the 5th, 10th, and 15th days after treatment per plant. Five plants from each net plot were selected randomly and tied with tags, while plants located at border were avoided for recording observations.

Treatment details

Treatments	Name of Biopesticides	Dosage (gm or ml/lit)
T ₁	<i>Lecanicillium lecanii</i> 1.15% WP	5 gm
T ₂	<i>Metarhizium anisopliae</i> 1.15% WP	5 gm
T ₃	<i>Beauveria bassiana</i> 1.15% WP	5 gm
T ₄	<i>Lecanicillium lecanii</i> 1.15% WP	10 gm
T ₅	<i>Metarhizium anisopliae</i> 1.15% WP	10 gm
T ₆	<i>Beauveria bassiana</i> 1.15% WP	10 gm
T ₇	Neem oil 10000 ppm	2 ml
T ₈	Untreated Control	--

Result and Discussion

Effect of different Biopesticides on ladybird beetle (*Coccinella transversalis* F.): The data pertaining to impact of biopesticides on *Coccinellids* on *Bt* cotton during Kharif-2023 are presented in Table 1 The *Coccinellids* population recorded, a day before spraying (DBS) varied between 2.33 and 2.67 *Coccinellids* beetle per plant

After first spray

At 5 Days after spraying (DAS), Maximum population of *Coccinellids* was recorded in untreated control (2.53 beetle plant⁻¹). *L. lecanii* 1.15% WP @ 2500g ha⁻¹ found to be safe as it recorded highest population of *Coccinellids* (2.40 beetle plant⁻¹) among the biopesticides but the difference among treatments was statistically non-significant. *L. lecanii* 1.15% WP @ 2500g ha⁻¹ (2.36 beetle plant⁻¹) found to be safe as it recorded highest population of *Coccinellids* (2.75 beetle plant⁻¹) among the other biopesticides and maximum population of *Coccinellids* was observed in untreated control (2.73 beetle plant⁻¹) in experimental field but the difference among treatments was statistically non-significant. At 15 DAS almost a similar trend of effectiveness was noticed.

After second spray

At 5 DAS, least population of *Coccinellids* was observed in *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (2.19 beetle plant⁻¹), while the untreated control was significantly superior over

rest of the treatments. The difference among biopesticides was statistically non-significant. At 10 DAS, *L. lecanii* 1.15% WP @ 2500g ha⁻¹ (2.50 beetles plant⁻¹) found to be safe as it recorded highest population of *Coccinellids* among the other biopesticides and at par with *L. lecanii* 1.15% WP @ 5000g ha⁻¹ (2.47 beetles plant⁻¹), neem oil 10000ppm @ 1000 ml ha⁻¹ (2.40 beetles plant⁻¹), *M. anisopliae* 1.15 % WP @ 2500g ha⁻¹ (2.36 beetles plant⁻¹), *M. anisopliae* 1.15 % WP @ 5000g ha⁻¹ (2.30 beetles plant⁻¹) and *B. bassiana* 1.15 % WP @ 2500g ha⁻¹ (2.26 beetles plant⁻¹). The next followed treatment was *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (1.98 beetle plant⁻¹). The maximum population of *Coccinellids* was recorded in (3.07 beetle plant⁻¹) control. There was a slight increase in *Coccinellids* population at 15 DAS, the maximum population of *Coccinellids* was observed in control (3.33 beetle plant⁻¹). Treatment with *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (2.13 beetle plant⁻¹) was observed least population of *Coccinellids*, considered as most toxic to the population of *Coccinellids* beetles. Similar trend was observed among the other biopesticides.

After third spray

At 5 DAS, Plot Treatment with *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (1.98 beetle plant⁻¹) was observed lowest population of *Coccinellids*, Considered as most toxic to the population of *Coccinellids* beetle. but the difference among treatments was statistically non-significant. The maximum population in experimental plot was observed in untreated control (3.53 beetle plant⁻¹) at 10 DAS. Treatment *L. lecanii* 1.15% WP @ 2500g ha⁻¹ (2.33 beetles plant⁻¹) found to be safe as it recorded highest population of *Coccinellids* among the other biopesticides and at par with *L. lecanii* 1.15% WP @ 5000g ha⁻¹ (2.26 beetles plant⁻¹), neem oil 10000ppm @ 1000ml ha⁻¹ (2.20 beetles plant⁻¹), *M. anisopliae* 1.15 % WP @ 2500g ha⁻¹ (2.36 beetles plant⁻¹) followed by *M. anisopliae* 1.15 % WP @ 5000g ha⁻¹ (2.36 beetles plant⁻¹) at par with *B. bassiana* 1.15 % WP @ 2500g ha⁻¹ (1.76 beetles plant⁻¹) and *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (1.67 beetle plant⁻¹). At 15 DAS, *L. lecanii* 1.15% WP @ 2500g ha⁻¹ found to be safe as it recorded highest population of *Coccinellids* (2.67 beetles plant⁻¹) at par with *L. lecanii* 1.15% WP @ 5000g ha⁻¹ (2.56 beetles plant⁻¹), neem oil 10000ppm @ 1000 ml ha⁻¹ (2.46 beetles plant⁻¹), *M. anisopliae* 1.15 % WP @ 2500g ha⁻¹ (2.33 beetles plant⁻¹) and *M. anisopliae* 1.15 % WP @ 5000g ha⁻¹ (2.23 beetle plant⁻¹) followed by *B. bassiana* 1.15 % WP @ 2500g ha⁻¹ (2.13 beetle plant⁻¹) at par with *B. bassiana* 1.15 % WP @ 5000g ha⁻¹ (1.98 beetle plant⁻¹), which was recorded lowest population on *Coccinellids*. The maximum population of *Coccinellids* was recorded in untreated control (3.87 beetle plant⁻¹).

Table 1: Efficacy of different biopesticides *coccinellids* under field conditions during Kharif- 2023

Tr. No.	Treatmentdetails	Dose (g or ml/h)	No. of <i>coccinellids</i> /plant									Mean	
			PTC	After first spray			After second spray			After third spray			
				5 DAS	10 DAS	15 DAS	5 DAS	10 DAS	15 DAS	5 DAS	10 DAS		15 DAS
T ₁	<i>L. lecanii</i> 1.15% W.P	5	2.47 (1.72)	2.40 (1.70)	2.36 (1.69)*	2.67 (1.78)	2.53 (1.74)	2.50 (1.73)	2.56 (1.75)	2.47 (1.72)	2.33 (1.68)	2.67 (1.78)	2.50 (1.73)
T ₂	<i>M. anisopliae</i> 1.15% W.P	5	2.33 (1.68)	2.33 (1.68)	2.20 (1.64)	2.53 (1.74)	2.38 (1.70)	2.36 (1.69)	2.40 (1.70)	2.20 (1.64)	1.98 (1.57)	2.33 (1.68)	2.30 (1.67)
T ₃	<i>B. bassiana</i> 1.15% W.P	5	2.40 (1.70)	2.27 (1.66)	2.07 (1.60)	2.40 (1.70)	2.26 (1.66)	2.26 (1.66)	2.26 (1.66)	2.00 (1.58)	1.76 (1.50)	2.13 (1.62)	2.16 (1.63)
T ₄	<i>L. lecanii</i> 1.15% W.P	10	2.33 (1.68)	2.40 (1.70)	2.32 (1.68)	2.60 (1.76)	2.50 (1.73)	2.47 (1.72)	2.53 (1.74)	2.40 (1.70)	2.26 (1.66)	2.56 (1.75)	2.45 (1.72)

T ₅	<i>M. anisopliae</i> 1.15% W.P	10	2.53 (1.74)	2.30 (1.67)	2.13 (1.62)	2.47 (1.72)	2.30 (1.67)	2.30 (1.67)	2.36 (1.69)	2.13 (1.62)	1.87 (1.54)	2.23 (1.65)	2.23 (1.65)
T ₆	<i>B. bassiana</i> 1.15% W.P	10	2.67 (1.78)	2.23 (1.65)	1.98 (1.57)	2.33 (1.68)	2.19 (1.64)	1.98 (1.57)	2.13 (1.62)	1.98 (1.57)	1.67 (1.47)	1.98 (1.57)	2.05 (1.60)
T ₇	Neem oil @ 10000 ppm	2	2.47 (1.72)	2.35 (1.69)	2.29 (1.67)	2.56 (1.75)	2.47 (1.72)	2.40 (1.70)	2.47 (1.72)	2.33 (1.68)	2.20 (1.64)	2.46 (1.72)	2.39 (1.70)
T ₈	Untreated control		2.47 (1.72)	2.53 (1.74)	2.73 (1.80)	2.83 (1.82)	2.98 (1.87)	3.07 (1.89)	3.33 (1.96)	3.47 (1.74)	3.53 (2.01)	3.87 (2.09)	3.15 (1.91)
	S. Em ±		0.046	0.046	0.044	0.048	0.047	0.046	0.047	0.044	0.043	0.047	0.032
	CD @ 5%		NS	NS	NS	NS	NS	0.139	0.142	NS	0.130	0.142	0.097

*Figures in the parentheses are square root transformed values, NS: Non-significant, PTC: Pre-treatment count, DAS: Days after spraying

Overall mean effect of three sprays

The observations data on the effect of various biorationals on the population of Coccinellids on *Bt* cotton after three sprayings separated by 15 days presented in the table 1 The research concluded that *L. lecanii* 1.15% WP @ 2500g ha⁻¹ were better treatments for Coccinellids along with untreated control recorded the highest number of population. The safety level of biorationals against Coccinellids predator i.e. lady bird beetle in descending order is as follows *L. lecanii* 1.15% WP @ 2500g ha⁻¹ > *L. lecanii* 1.15% WP @ 5000g ha⁻¹ > neem oil 10000ppm @ 1000 ml ha⁻¹ > *M. anisopliae* 1.15 % WP @ 2500g ha⁻¹ > *M. anisopliae* 1.15 % WP @ 5000g ha⁻¹ > *B. bassiana* 1.15 % WP @ 2500g ha⁻¹ > *B. bassiana* 1.15 % WP @ 5000g ha⁻¹.

Derekhshan *et al.*, (2007) [3] concluded that *V. lecanii* was not pathogenic to NE's i.e. *C. septempunctata*. Meena *et al.*, (2013) observed that plot treated with *V. lecanii* @ 5g/lit found maximum population of coccinellids (*C. septempunctata*) in cabbage crop. Ramanujam *et al.*, (2017) [6] reported that entomopathogenic fungi isolates have no detrimental effect on *C. septempunctata* and can be considered as safe. Gawali *et al.*, (2023) [4] he studied that the effect of Bio pesticides against the ladybird beetle and found that the *Lecanicillium lecanii* was the safer and better treatments which shows highest number of lady bird beetle i.e. coccinellids beetle. The safety level of bio-rational against Coccinellids predator ladybird beetle i.e. coccinellids beetle in ascending order is as follows emamectin benzoate < NSKE 5% < *Metarhizium anisopliae* < Neemshree 10000 ppm < *Beauveria bassiana* < spinosad < *Lecanicillium lecanii*.

Conclusion

In the untreated control plot the number of ladybird beetle was more than treated plot. Among the Biopesticides, the overall data reveals that biopesticides had no or little impact on the population of Coccinellids. Whereas, *L. lecanii* 1.15% WP @ 2500g ha⁻¹, which recorded the highest population of beetles and proved safer as compared to other biopesticides. The safety level of biorationals against Coccinellids predator i.e. lady bird beetle in descending order is as follows *L. lecanii* 1.15% WP @ 2500g ha⁻¹ > *L. lecanii* 1.15% WP @ 5000g ha⁻¹ > neem oil 10000ppm @ 1000ml ha⁻¹ > *M. anisopliae* 1.15 % WP @ 2500g ha⁻¹ > *M. anisopliae* 1.15 % WP @ 5000g ha⁻¹ > *B. bassiana* 1.15 % WP @ 2500g ha⁻¹ > *B. bassiana* 1.15 % WP @ 5000g ha⁻¹.

Acknowledgment

It gives me great pleasure to express my deep sense of gratitude and sincere thanks to my research guide Dr. G. B. Kabre, Professor of entomology and Dr. Sojwal Shinde, Assistant Professor, College of Agriculture Dhule, MPKV, Rahuri. I am also thankful to Associate Dean of College of

Agriculture, Dhule and Senior Scientist of KVK, Dhule for providing necessary facilities and support for conducting the research successfully.

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