



Effect of Chlorantraniliprole 18.5% SC Applied Through Drone and Knapsack Sprayers on Ladybird Beetle and Spider Populations in Soybean (*Glycine max* (L.) Merrill)

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Received: 07 Sep 2026; Received in revised form: 01 Oct 2026; Accepted: 05 Oct 2026; Available online: 15 Oct 2026

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Abstract— The field experiment was conducted during Kharif 2025 at the research farm of the National Agriculture Research Project (NARP), Chhatrapati Sambhajinagar, Maharashtra, to evaluate the effect of drone and conventional knapsack application of chlorantraniliprole 18.5% SC on natural enemies associated with soybean, *Glycine max* (L.) Merrill. The experiment included different doses of chlorantraniliprole applied through a drone, a conventional knapsack sprayer, and an untreated control. Populations of spiders and ladybird beetles were recorded before and after each spray. Following the first spray, the untreated control (T_0) recorded the highest mean populations of spiders (1.86 spiders/m²) and ladybird beetles (1.88 beetles/m²), whereas T_3 (chlorantraniliprole 18.5% SC @ 187.5 ml/ha through drone) recorded the lowest populations of spiders (1.51 spiders/m²) and ladybird beetles (1.42 beetles/m²). Similarly, after the second spray, the highest populations of spiders (1.95 spiders/m²) and ladybird beetles (1.93 beetles/m²) were recorded in T_0 , while the lowest populations of spiders (1.43 spiders/m²) and ladybird beetles (1.41 beetles/m²) were observed in T_3 . However, differences among treatments were statistically non-significant for both natural enemies. These findings indicate that the tested chlorantraniliprole 18.5 SC treatments did not produce statistically significant changes in spider and ladybird beetle populations under the experimental conditions.



Keywords— Soybean, *Glycine max*, Chlorantraniliprole 18.5% SC, Drone application, Ladybird beetle, Spider.

I. INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is an important legume and oilseed crop cultivated extensively in Maharashtra, particularly in the Marathwada region. Sustainable soybean production requires effective insect pest management along with the conservation of beneficial arthropods. Ladybird beetles (Coccinellidae) and spiders are important natural enemies that contribute to the suppression of insect pest populations and help maintain ecological balance in soybean agroecosystems. Chemical insecticides are widely used to manage insect pests in soybean; however, their

effects on beneficial arthropods need to be evaluated to support environmentally sustainable pest management practices. Drone-based pesticide application is emerging as an alternative to conventional spraying methods because of its operational efficiency and lower spray volume requirements. Nevertheless, the effects of insecticides applied through drones on beneficial arthropod populations under field conditions require further investigation. In view of these considerations, the present investigation was undertaken during the kharif season of 2025 at the NARP research farm, Chhatrapati Sambhajinagar, Maharashtra, to evaluate the effects of different doses of chlorantraniliprole

18.5% SC applied through a drone sprayer, in comparison with a conventional knapsack sprayer, on ladybird beetle and spider populations in soybean.

II. MATERIALS AND METHOD

The experiment was conducted during *kharif* 2025 at the research farm of National Agriculture Research Project (NARP), Chh. Sambhajinagar, to evaluate the efficacy of Chlorantraniliprole 18.5% SC against major defoliator insect pests of soybean through drone application under field conditions. The experimental field was prepared by ploughing followed by harrowing and levelling. The field experiment was laid out in Randomized Block Design (RBD) with five treatments replicated four times. Soybean variety MAUS 71 was sown at a spacing of 45×5 cm following the recommended package of practices.

Table 1. Experimental Details

Sr. No.	Particulars	Details
1	Design	RBD
2	Treatments	05
3	Replications	04
4	Spacing	45×5 cm
5	Plot size	500 m ²
6	Variety	MAUS 71
7	Season	<i>Kharif</i> 2025
8	Date of sowing	04 July 2025
9	Number of sprays	02
10	Spray interval	15 days
11	Drone spray volume	25 L/ha
12	Knapsack spray volume	500 L/ha

Table 2. Treatment Details :

Sr. No.	Treatments	Dose (ml ha ⁻¹)	Method of application	Spray volume
1	T ₁ – Chlorantraniliprole 18.5% SC	112.5 (0.75X)	Drone	25 L/ha
2	T ₂ – Chlorantraniliprole 18.5% SC	150.0 (1X)	Drone	25 L/ha
3	T ₃ – Chlorantraniliprole 18.5% SC	187.5 (1.25X)	Drone	25 L/ha
4	T ₄ – Chlorantraniliprole 18.5% SC	150.0 (1X)	Knapsack sprayer	500 L/ha
5	T ₅ – Untreated control	–	–	–

Imposition of Treatments

The first spray was applied on 25 August 2025, followed by the second spray on 10 September 2025. Treatments T₁ (112.5 ml/ha), T₂ (150 ml/ha) and T₃ (187.5 ml/ha) were applied using a drone sprayer at 25 L/ha, while T₄ (150 ml/ha) was applied using a knapsack sprayer at 500 L/ha. T₅ was maintained as an untreated control. Ladybird beetle and spider populations were recorded before and after spraying.

Method of recording Observations

Observations were recorded on the total number of natural enemies *viz.*, Ladybird Beetles and spider. per metre row length from three selected places per replication before spray and at 1, 3, 7 and 10 days after the 1st and 2nd sprays.

The collected data were subjected to Analysis of Variance (ANOVA) suitable for a Randomized Block Design (RBD), as described by Gomez and Gomez (1984). Treatment means were compared using the Critical Difference (CD) test at a 5% level of significance ($P = 0.05$).

Table 3. Population of spider after spray. (1st and 2nd Spray)

Tr. No	Treatments	Method	Dosage ml/ha	Average spiders / mrl.										
				1 st Spraying						2 nd Spraying				
				1 DBS	1 DAS	3 DAS	7 DAS	10 DAS	Mean	1 DAS	3 DAS	7 DAS	10 DAS	Mean
T ₁	Chlorantraniliprole 18.5 SC	Drone	112.5	1.87 (1.54)	1.75 (1.50)	1.69 (1.48)	1.55 (1.43)	1.63 (1.46)	1.70 (1.48)	1.72 (1.49)	1.67 (1.47)	1.59 (1.45)	1.63 (1.46)	1.64 (1.47)
T ₂	Chlorantraniliprole 18.5 SC	Drone	150	1.85 (1.53)	1.67 (1.47)	1.53 (1.42)	1.49 (1.41)	1.55 (1.43)	1.60 (1.46)	1.63 (1.46)	1.54 (1.43)	1.50 (1.41)	1.51 (1.42)	1.55 (1.43)
T ₃	Chlorantraniliprole	Drone	187.5	1.86	1.62	1.35	1.30	1.40	1.51	1.57	1.44	1.32	1.38	1.43

	18.5 SC			(1.54)	(1.46)	(1.36)	(1.34)	(1.38)	(1.41)	(1.44)	(1.39)	(1.35)	(1.37)	(1.38)
T ₄	Chlorantraniliprole 18.5 SC	Knapsack sprayer	150	1.86 (1.54)	1.65 (1.47)	1.56 (1.44)	1.48 (1.41)	1.58 (1.44)	1.62 (1.45)	1.69 (1.48)	1.59 (1.45)	1.39 (1.37)	1.49 (1.41)	1.54 (1.43)
T ₅	Untreated (Control)	-	-	1.80 (1.52)	1.82 (1.52)	1.85 (1.53)	1.90 (1.55)	1.95 (1.57)	1.86 (1.54)	1.82 (1.52)	1.92 (1.56)	2.00 (1.58)	2.07 (1.60)	1.95 (1.57)
	S.E.(m) ±			0.07	0.06	0.06	0.07	0.06	0.07	0.07	0.08	0.06	0.07	0.07
	C.D. at 5%			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	C.V.			12.50	11.94	11.21	12.64	12.73	12.20	11.42	12.02	11.53	12.93	11.98

(Figures in the parentheses are $\sqrt{x + 0.5}$ transformed values)

Population of Spiders After First Spray

The data presented in Table 3 indicated that the mean spider population was highest in the untreated control (T₅) (1.86 spiders/mrl), followed by T₁ (1.70), T₄ (1.62), T₂ (1.60) and T₃ (1.51 spiders/mrl). Treatment T₃, chlorantraniliprole 18.5 SC @ 187.5 ml/ha applied through a drone, recorded the lowest population. However, differences among treatments were statistically non-significant.

Population of Spiders After Second Spray

As presented in Table 3, the highest mean spider population was recorded in the untreated control (T₅) (1.95 spiders/mrl), while the lowest was observed in T₃ (1.43 spiders/mrl), chlorantraniliprole 18.5 SC @ 187.5 ml/ha applied through a drone. The differences among treatments

were statistically non-significant, indicating no significant adverse effect on spider populations.

Reddy *et al.* (2024) observed no significant adverse effect of chlorantraniliprole 18.5% SC on spider populations under field conditions. Nadagoud *et al.* (2024) also reported no significant adverse impact on spiders following chlorantraniliprole application. Biradar *et al.* (2023) and Liyas *et al.* (2015) reported comparatively lower toxicity of chlorantraniliprole to beneficial arthropods, including spiders, than broad-spectrum insecticides. Similarly, Natikar *et al.* (2015) found chlorantraniliprole 18.5% SC to be comparatively safer to spiders under field conditions. These findings are in agreement with the present study, in which differences in spider populations among treatments were statistically non-significant.

Table 4 Population of ladybird beetle after spray. (1st and 2nd Spray)

Tr. No	Treatments	Method	Dosage ml/ha	Average ladybird beetle / mrl.										
				1 st Spraying						2 nd Spraying				
				1 DBS	1 DAS	3 DAS	7 DAS	10 DAS	Mean	1 DAS	3 DAS	7 DAS	10 DAS	Mean
T ₁	Chlorantraniliprole 18.5 SC	Drone	112.5	1.79 (1.51)	1.75 (1.50)	1.59 (1.45)	1.50 (1.41)	1.67 (1.47)	1.66 (1.46)	1.70 (1.48)	1.56 (1.43)	1.47 (1.40)	1.60 (1.45)	1.58 (1.44)
T ₂	Chlorantraniliprole 18.5 SC	Drone	150	1.84 (1.53)	1.67 (1.47)	1.42 (1.38)	1.33 (1.35)	1.45 (1.39)	1.54 (1.43)	1.65 (1.46)	1.52 (1.42)	1.43 (1.39)	1.49 (1.41)	1.53 (1.43)
T ₃	Chlorantraniliprole 18.5 SC	Drone	187.5	1.84 (1.53)	1.50 (1.41)	1.25 (1.32)	1.17 (1.29)	1.33 (1.35)	1.42 (1.39)	1.56 (1.43)	1.40 (1.38)	1.29 (1.34)	1.38 (1.37)	1.41 (1.38)
T ₄	Chlorantraniliprole 18.5 SC	Knapsack sprayer	150	1.89 (1.54)	1.75 (1.50)	1.47 (1.40)	1.42 (1.38)	1.50 (1.41)	1.61 (1.45)	1.68 (1.47)	1.52 (1.42)	1.46 (1.40)	1.52 (1.42)	1.55 (1.43)
T ₅	Untreated (Control)	-	-	1.80 (1.52)	1.82 (1.52)	1.86 (1.54)	1.91 (1.55)	1.98 (1.57)	1.88 (1.54)	1.85 (1.53)	1.90 (1.55)	1.96 (1.57)	2.01 (1.58)	1.93 (1.56)
	S.E.(m) ±			0.06	0.05	0.06	0.07	0.06	0.06	0.07	0.06	0.05	0.07	0.06
	C.D. at 5%			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	C.V.			11.89	12.82	11.86	12.71	12.62	11.93	12.16	12.53	11.31	11.92	11.23

Population of Ladybird Beetle After First Spray

The data presented in Table 4 indicated that the mean ladybird beetle population was highest in the untreated control (T_s) (1.88 beetles/mrl), followed by T₁ (1.66), T₂ (1.54), T₄ (1.51) and T₃ (1.42 beetles/mrl). Treatment T₃, comprising chlorantraniliprole 18.5 SC @ 187.5 ml/ha applied using a drone, recorded the lowest mean population. However, the differences among treatments were statistically non-significant.

Population of Ladybird Beetle After Second Spray

The data presented in Table 4 revealed that the highest mean ladybird beetle population was recorded in the untreated control (T_s) (1.93 beetles/mrl), followed by T₁ (1.58), T₄ (1.55), T₂ (1.53) and T₃ (1.41 beetles/mrl). Treatment T₃, comprising chlorantraniliprole 18.5 SC @ 187.5 ml/ha applied using a drone, recorded the lowest mean population. However, the differences among treatments were statistically non-significant, indicating no significant adverse effect on ladybird beetle populations under the experimental conditions.

Nadagoud *et al.* (2024) also observed no significant adverse impact of chlorantraniliprole on coccinellids and spiders. In soybean ecosystem, Biradar *et al.* (2023) and Liyas *et al.* (2015) reported that selective molecules like chlorantraniliprole 18.5 SC exhibited lower toxicity and were comparatively safer to natural enemies than broad spectrum insecticides. Cong *et al.* (2023) demonstrated that chlorantraniliprole cause a low risk and hazard quotient to the predatory ladybird beetle (*Coccinella septempunctata*) compared with other diamides. Earlier, Natikar *et al.* (2015) observed chlorantraniliprole 18.5 SC to be safer to coccinellids, while He *et al.* (2019) confirmed its low contact toxicity at recommended field rates. These findings corroborate the present study, indicating the relative safety of drone applied chlorantraniliprole towards predatory ladybird beetles.

III. CONCLUSION

The mean populations of spiders and ladybird beetles were numerically highest in the untreated control (T_s) and lowest in T₃ (chlorantraniliprole 18.5 SC @ 187.5 ml/ha applied through a drone) after both sprays. However, the differences among treatments were statistically non-significant. Thus, although T₃ recorded comparatively lower populations of these beneficial arthropods, the observed reductions were not statistically significant and did not demonstrate a significant adverse effect under the experimental conditions. These findings are consistent with previous studies reporting the relative safety of chlorantraniliprole to spiders and predatory ladybird beetles.

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