



Bio-efficacy of newer insecticides and bio-pesticides against termite on chickpea in arid region of Rajasthan

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Summary

The seed treatment, as well as soil application of imidacloprid 600 FS @ 5 ml/kg + *Beauveria bassiana* 1.15 WP @ 2 kg /ha, was found most effective against termite (9.34% plant damage) after 110 days of crop sowing, followed by fipronil 5 SC @ 5 ml/ kg + *Metarhizium anisopliae* 1.15 WP @ 2 kg/ha (10%) and clothianidin 50 WDG @ 2 g/ kg + *Beauveria bassiana* 1.15 WP @ 2 kg /ha (10.62%). The treatments alone seed treatment of imidacloprid 600 FS @ 5 ml/ kg seed (11.56%) followed by fipronil 5 SC @ 5 ml/ kg seed (12.03%) and clothianidin 50 WDG @ 2 g/ kg seed (12.65%) were found moderately effective while, bio-pesticides viz., *Metarhizium anisopliae* 1.15 WP @ 2 kg/ha and *Beauveria bassiana* 1.15 WP @ 2 kg /ha with 15.78 and 15.47 per cent plant damage were found least effective for controlling the termite population. The maximum yield was obtained in imidacloprid 600 FS + *Beauveria bassiana* 1.15 WP (18.70 q ha⁻¹) followed by fipronil 5 SC + *Metarhizium anisopliae* 1.15 WP (18.20 q ha⁻¹) and clothianidin 50 WDG + *Beauveria bassiana* 1.15 WP (18.00 q ha⁻¹), respectively.

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Introduction

Chickpea, *Cicer arietinum* (L.) is one of the most important Rabi season pulse crops. In India, the area under chickpea is 9.99 million hectares with an annual production of about 11.91 million tones and a productivity of 1192 kg/ ha, and in Rajasthan, it occupied 2.11 million hectares area and an annual production of 2.26 million tones with a productivity of 1072 kg/ ha (Anonymous, 2020-21). The chickpea is attacked by more than 36 species of insect-pests, out of them, termite is the major significance of this crop. Termite damage the seedling by cutting just below or above the soil surface. In mature plants, it feeds on roots and inside the stem. Termites are regular pest in tropical and sub-tropical parts of India. In Rajasthan, the situation is more alarming as the termite inflict heavy damage to the crops in sandy loam soils. It attacks the crop throughout the growth stages, damage caused during flowering and pod formation stages results in substantial yield loss up to 90% (Patil et al. 2017).

The most important species attacking crops were *Microtermes obesi* and *Odontotermes obesus* (Roonwal 1981; Rajagopal 2002). The exploitation of biocontrol agents and newer insecticides is considered a suitable alternative to the use of synthetic chemical pesticides. The entomopathogenic fungi viz., *Beauveria bassiana*, *Metarhizium anisopliae* and *Verticillium lecanii* are pathogenic to a wide range of insect pests including termite (Milner 2003; Michael 2005; Haldhar &

Maheshwari 2021). However, the report on the use of entomopathogenic fungi for the management of termites in India is very meagre deposited the economic importance of termites as insect pest (Haldhar et al. 2013). Therefore, the present study was undertaken to test the efficacy of newer insecticides and bio-pesticides against termite in chickpea, *Cicer arietinum* (L.)

Material and Methods

The present investigation was conducted at Agronomy Farm, College of Agriculture, Swami Keshwanad Rajasthan Agricultural University; Bikaner during two consecutive seasons i.e. Rabi 2021-22 and 2022-23. The experiment was laid out in simple Randomized Block Design with nine treatments including untreated control each replicated thrice. The treatments were seed treatment of imidacloprid 600 FS @ 5 ml/ kg seed, clothianidin 50 WDG @ 2 gm/ kg seed and fipronil 5 SC @ 5 ml/ kg seed; soil application of *Beauveria bassiana* 1.15 WP @ 2 kg /ha and *Metarhizium anisopliae* 1.15 WP @ 2 kg/ha and seed treatment along with soil application of imidacloprid 600 FS @ 5 ml/kg + *B. bassiana* 1.15 WP @ 2 kg /ha, clothianidin 50 WDG @ 2 gm/ kg + *B. bassiana* 1.15 WP @ 2 kg /ha and fipronil 5 SC @ 5 ml/ kg + *M. anisopliae* 1.15 WP @ 2 kg/ha. Seed treatment as well as soil application of different treatments was carried out before sowing. The observations on termite incidence, infested and healthy plants of chickpea were counted at 10 days interval from each plot starting from 20 DAS till maturity of the crop and transformed into per cent plant damage.

Results and Discussions

In present study eight treatments were evaluated in comparison with control against termite. The results showed that seed treatment along with soil application of imidacloprid 600 FS @ 5 ml/kg + *Beauveria bassiana*

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1.15 WP @ 2 kg /ha was found to be most effective with minimum termite damage (8.12% & 10.55% plant damage) after 110 days of crop sowing followed by fipronil 5 SC @ 5 ml/ kg + *Metarrihizium anisopliae* 1.15 WP @ 2 kg/ha (8.75 % 11.24%) and clothianidin 50 WDG @ 2 g/ kg + *B. bassiana* 1.15 WP @ 2 kg /ha (9.37% & 11.87%), respectively during rabi 2021-22 and 2022-23. These treatments were found at par with each other in terms of efficacy. Seed treatment of imidacloprid 600 FS

@ 5 ml/ kg seed (10.31% & 12.81%) followed by fipronil 5 SC @ 5 ml/ kg seed (10.93 & 13.123%) and clothianidin 50 WDG @ 2 g/ kg seed (11.87% & 13.43%) were found moderately effective against termite while, bio-pesticides viz., *M. anisopliae* 1.15 WP @ 2 kg/ha (15.62% & 15.93%) and *B. bassiana* 1.15 WP @ 2 kg /ha (14.68% & 16.25% plant damage) were found least effective (Table 1; Fig.1 & 2).

Table 1. Effect of insecticides as seed and soil treatment against termite in chickpea

S. No.	Treatments	Termite damaged plants (%)			Seed Yield (q /ha)		
		110 days after sowing			2021-22	2022-23	Pooled
		2021-22	2022-23	Pooled			
1.	Seed treatment of Imidacloprid 600 FS @ 5 ml/ kg	10.31 (18.73)	12.81 (20.89)	11.56 (19.85)	18.40	16.05	17.23
2.	Seed treatment of Clothianidin 50 WDG @ 5 ml/ kg	11.87 (20.15)	13.43 (21.45)	12.65 (20.83)	17.75	15.20	16.48
3.	Seed treatment of Fipronil 5 SC @ 5 ml/ kg	10.93 (19.31)	13.12 (21.18)	12.03 (20.27)	18.05	15.80	16.93
4.	Soil application of <i>Beauveria bassiana</i> 1.15 WP @ 2 kg /ha	14.68 (22.44)	16.25 (23.75)	15.47 (23.15)	16.02	14.10	15.06
5.	Soil application of <i>Metarrihizium anisopile</i> 1.15 WP @ 2 kg /ha	15.62 (23.25)	15.93 (23.52)	15.78 (23.40)	16.05	13.92	14.99
6.	T-1 + soil application of <i>Beauveria bassiana</i> 1.15 WP @ 2 kg /ha	8.12 (16.55)	10.55 (18.94)	9.37 (17.76)	19.80	17.60	18.70
7.	T-2 + soil application of <i>Beauveria bassiana</i> 1.15 WP @ 2 kg /ha	9.37 (17.82)	11.87 (20.11)	10.62 (18.99)	19.05	16.95	18.00
8.	T-3 + soil application of <i>Metarrihizium anisopile</i> 1.15 WP @ 2 kg /ha	8.75 (17.21)	11.24 (19.56)	10.00 (18.40)	19.35	17.05	18.20
9.	Untreated control	22.50 (28.25)	25.06 (29.98)	23.78 (29.18)	15.30	13.15	14.23
	S.Em±	0.70	0.64	0.58	0.65	0.39	0.52
	C.D at 5%	2.12	1.92	1.67	1.87	1.13	1.50
	C.V	6.01	5.01	6.66	9.25	7.35	8.30

*Figure in parentheses is arcsine value

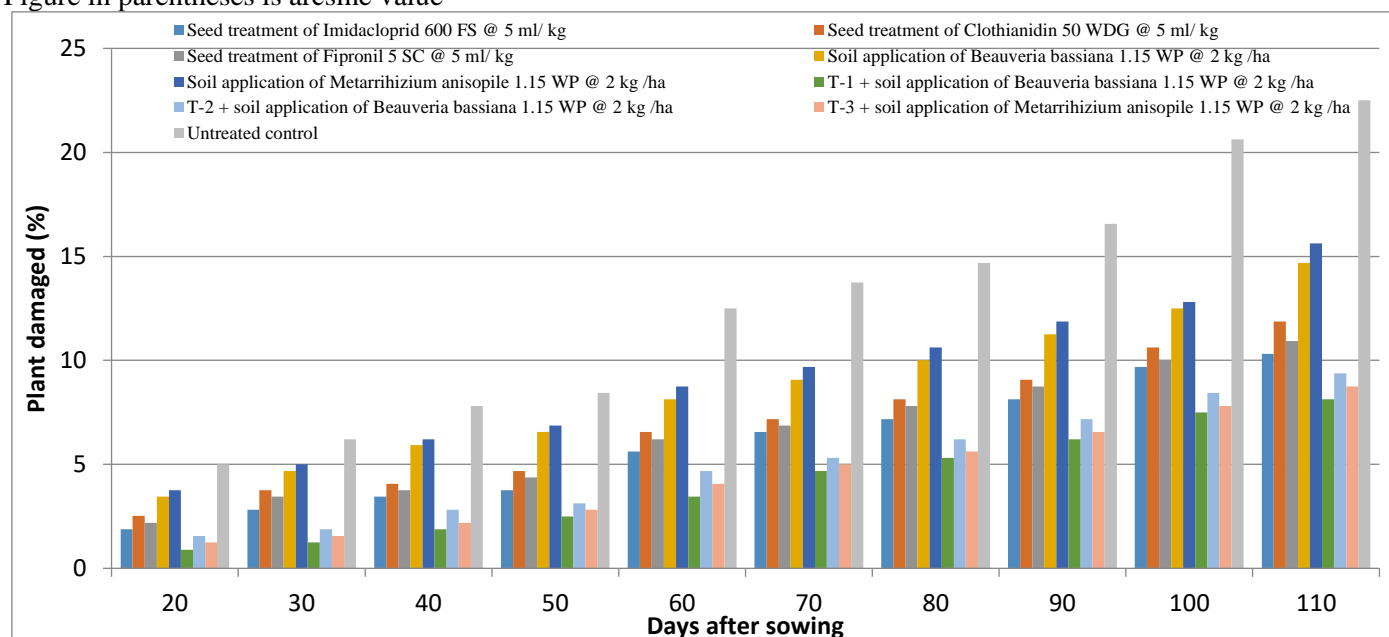


Figure 1. Effect of insecticides as seed and soil treatment against termite on chickpea during Rabi 2021-22

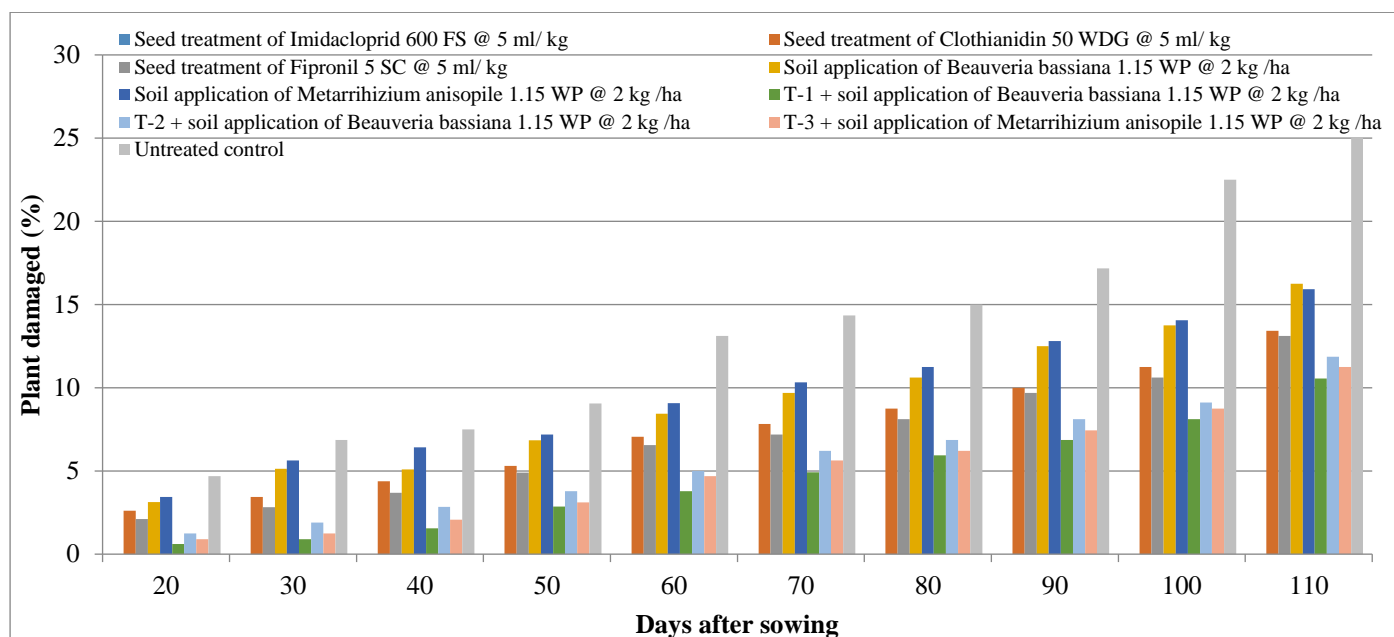


Figure 2. Effect of insecticides as seed and soil treatment against termite in chickpea during Rabi 2022-23

In pooled result, soil application of imidacloprid 600 FS @ 5 ml/kg + *Beauveria bassiana* 1.15 WP @ 2 kg /ha gave minimum termite damage (9.34%) after 110 days of crop sowing followed by fipronil 5 SC @ 5 ml/ kg + *Metarrhizium anisopliae* 1.15 WP @ 2 kg/ha (10%) and clothianidin 50 WDG @ 2 g/ kg + *B. bassiana* 1.15 WP @ 2 kg /ha (10.62%). The treatments alone seed treatment of imidacloprid 600 FS @ 5 ml/ kg seed (11.56%) followed by fipronil 5 SC @ 5 ml/ kg seed (12.03%) and clothianidin 50 WDG @ 2 g/ kg seed (12.65%) were found moderately effective. Bio-pesticides viz., *M. anisopliae* 1.15 WP @ 2 kg/ha and *B. bassiana* 1.15 WP @ 2 kg /ha with 15.78 and 15.47 per cent plant damage were found least effective against termite. The data on seed yield of chickpea revealed that maximum yield was recorded in the treatment of imidacloprid 600 FS @ 5 ml/kg + *B. bassiana* 1.15 WP @ 2 kg /ha (18.70 q ha⁻¹) followed by fipronil 5 SC @ 5 ml/ kg + *M. anisopliae* 1.15 WP @ 2 kg/ha (18.20 q ha⁻¹) and clothianidin 50 WDG @ 2 g/ kg + *B. bassiana* 1.15 WP @ 2 kg /ha (18.00 q ha⁻¹) and these were on par with each other (Table 1 and Fig. 1-3). The minimum yield was recorded in *M. anisopliae* 1.15 WP @ 2 kg/ha (14.99 q ha⁻¹) and *B. bassiana* 1.15 WP @ 2 kg /ha (15.06 q ha⁻¹) and both differed non-significantly (Fig. 4). While minimum seed yield was recorded in untreated plot (14.23 q ha⁻¹).

The effectiveness of these treatments in the present findings are in conformity with Panigrahi (2010) reported significantly lower plant damage by *O. obesus* in chickpea and maximum grain yield (1254 kg ha⁻¹) in the seed treatment of imidacloprid 10 ml/ kg seed. Bali et al.

(2010) recorded the lowest mean per cent damage of wheat tillers in fipronil and imidacloprid 200 SL. Kumar (2013) concluded that the seed treatment with imidacloprid 600 FS 3 ml/kg seed and clothianidin 50 WDG 2 gm/kg were most effective against *O. obesus* in wheat. Gadhiya and Borad (2013) observed that the seed treatment of fipronil 5 SC @ 5 ml/kg and imidacloprid 600 FS @ 3 ml/kg were highly effective in suppressing the termite population in wheat. There was no detrimental effect of the insecticides on seed germination and number of tillers in wheat. The results are partially in agreement with Parsai et al. (2014) reported seed treatment of chickpea with imidacloprid 70 WS effective against *O. obesus*. Amar Chand (2017) found Imidacloprid 600 FS @ 5ml/kg seed most effective against termite in chickpea and gave higher yield (1346 kg ha⁻¹). Kumar et al. (2018) reported significantly lowest per cent of plants damage due to the incidence of termite in the treatment of soil application of neem cake @ 2.5 q/ha along with seed treatment with fipronil 0.3% GR @ 25 kg/ha. Kumar et al. (2020) also found imidacloprid 600 FS @ 3 ml/ kg seed most effective against termite in wheat followed by clothianidin 50 WDG @ 2 gm/ kg seed. The effectiveness of biopesticides viz., *M. anisopliae* 1.15 WP and *B.bassiana* 1.15 WP are in agreement with Rana and Kachhawa (2014) reported that the bio-agents *B.bassiana*, *M. anisopliae* and *Paecilomyces fumosoroseus* @ 5x10¹³ spore /ha gave the promising results in suppression of termite population in the maize field.

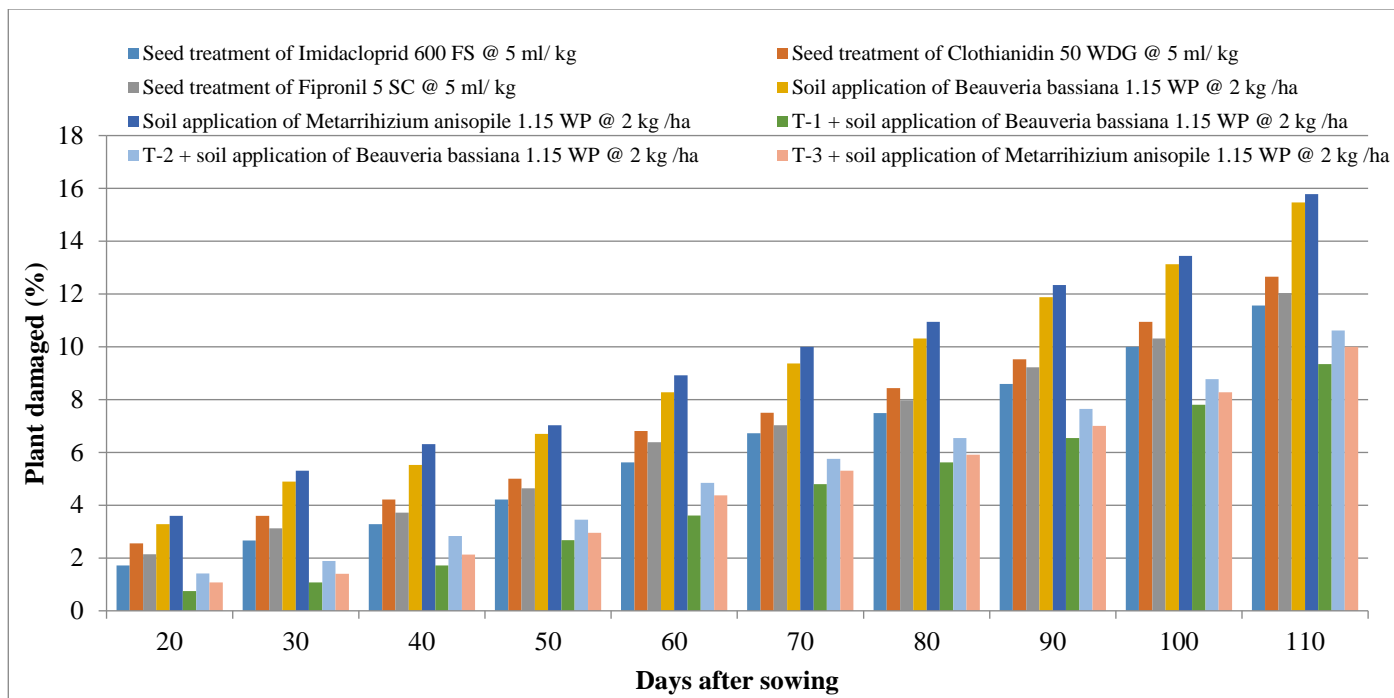


Figure 3. Effect of insecticides as seed and soil treatment against termite on chickpea during Rabi, 2021-23 (Pooled)

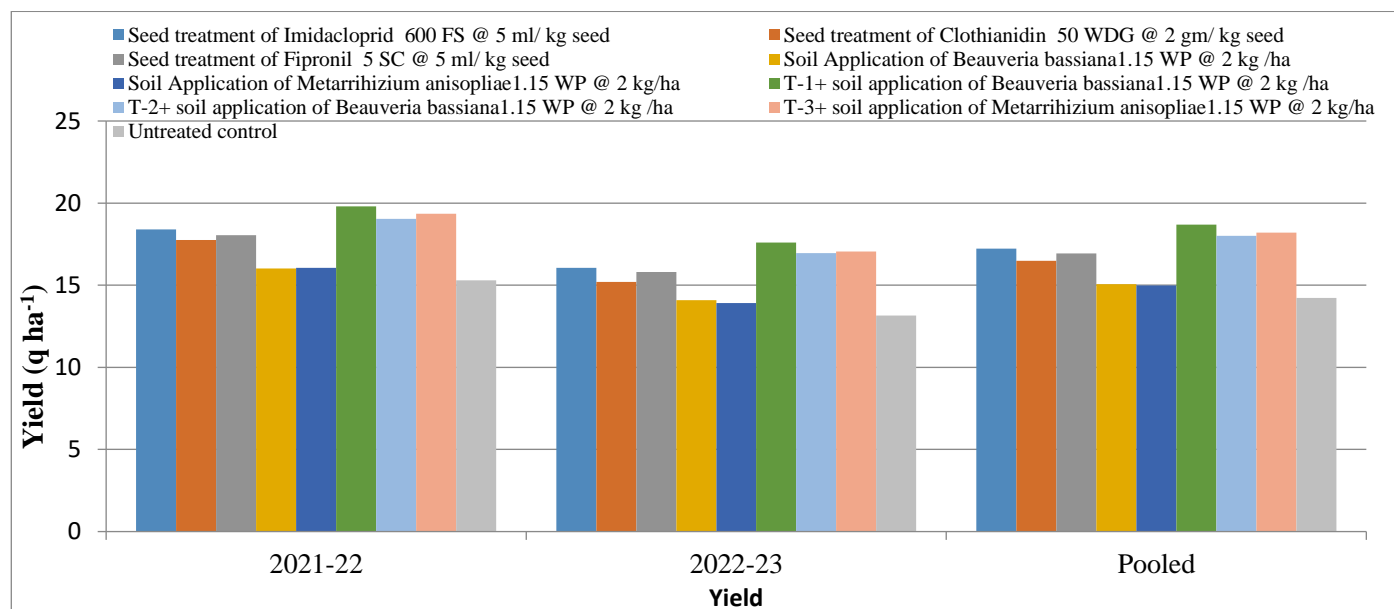


Figure 4. Graphical representation of effect of insecticides as seed and soil treatment on seed yield against termite on chickpea during Rabi, 2021-23

Conclusion

The seed treatment and soil application of imidacloprid 600 FS @ 5 ml/kg + *Beauveria bassiana* 1.15 WP @ 2 kg /ha was found to be most effective with minimum termite damage of 9.34 per cent followed by fipronil 5 SC @ 5 ml/ kg + *Metarhizium anisopliae* 1.15 WP @ 2 kg/ha (10%) and clothianidin 50 WDG @ 2 g/ kg + *Beauveria bassiana* 1.15 WP @ 2 kg /ha (10.62%).

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Declaration of Interests

The authors have no conflict of interest to declare.

Data Sharing

All relevant data are within the manuscript.

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