Plant Archives Vol. 25, Supplement 1, 2025 pp.2259-2263 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.311

BIOEFFICACY OF A NEW DIAMIDE MOLECULE, TETRANILIPROLE 200 SC AGAINST *CHILO PARTELLUS* IN MAIZE

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ABSTRACT

Field experiment was designed to evaluate the efficacy of a new diamide insecticide against Maize stem borer *Chilo partellus* under field condition during two years at the Main Agricultural Research Station (MARS), University of Agricultural Sciences, Dharwad during *Kharif 2022* & *Kharif 2023*. Results revealed that during both the years of investigation, Tetraniliprole 200 g/L SC @ 30 gai/ha was found to be an efficient way to increase grain and cob yield while decreasing the *Chilo partellus* population in the maize crop. All the dosages of tetraniliprole have excelled in recording less infestation and were equally effective to the standard check (Dimethoate). Even though tetraniliprole 200 g/L SC @ 40 and 50 gai/ha has produced good results at higher dosages, smaller dosages that have produced good results can be taken into consideration for subsequent applications.

Keywords **:** *Chilo partellus*, Maize, Tetraniliprole

Introduction

Maize (*Zea mays* L.) is a highly adaptable crop that can thrive in a variety of agroclimatic situations. Maize is referred to as the "Queen of Cereals" worldwide due to its high genetic yield potential among all cereals (Manjanagouda and Kalyanamurthy, 2018). Approximately 1147.7 million metric tonnes of maize is produced worldwide from 193.7 million hectares with an average yield of 5.75 tonnes per hectare in 170 countries with a variety of soil, climate, biodiversity, and management practices. This accounts for 36% of global grain production (Shekhar and Singh, 2021). Around the world, maize is utilized extensively for a variety of uses, including industrial (22%), food (17%), and feed (61%). The risk components have also increased as a result of the significant expansion of the area planted to maize and its higher cultivation. 140 distinct bug species, each with a varying amount of damage, attack maize. Among them, only 12 are major maize pests that harm the crop from planting to harvesting and storage conditions (Siddiqui and Marwaha 1993; Prakash and Venkataramana, 2023). Insects such as army worms, stem borer, thrips, aphids, termites, white grubs, seed corn maggots, root worms, Indian meal moths, grain borer and grain weevil damage maize crops while they are being stored. The spotted stem borer, *Chilo partellus* (Swinhoe), is the most damaging one during *kharif* causing 26.7-80.4 per cent yield losses in different agro-climate regions of India. Initially, the first three larval instars consume by scraping across the leaf whorls of developing plants, resulting in symptoms that resemble "window-paning" and "pin-holes." The mature larvae then tunnel within the central shoot, producing "dead hearts" in cases of severe infestation and causing the plant to die completely (Reyes, 1987 and Neupane *et al.,* 2022). A

single stem borer can reduce potential output by 8–10%, and that the pest is the most prevalent, accounting for 89.5 percent of all stem borers (War et al., 2023). As an internal feeder, *C. partellus* must be controlled by applying effective pesticides with various modes of action at the right crop stage. Insecticide resistance, on the other hand, makes management difficult and demands the use of more recent pesticides. Tetraniliprole, [1-(3-chloro-2-pyridyl)-4'-cyano-2'- methyl-6'-methylcarbamoyl-3-{[5-(trifluoromethyl)-2Htetrazol-2-yl]methyl}pyrazole-5-carboxanilide], belongs to phthalic acid diamide group which includes effective and widely used insecticides like flubendiamide, chlorantraniliprole and cyantraniliprole (Neethipudi *et al*., 2020 andKousika *et al*., 2017). The suggested dosage balances cost-effectiveness, safety, effectiveness, and environmental responsibility. Variations from this dosage can raise hazards, impair pest control, and cause resistance or environmental harm in the long run. Given this, the current study aims to assess the efficaciousness of 200 SC of tetraniliprole against *C. partellus* in maize.

Materials and Methods

A field experiment was conducted at Main Agricultural Research Station (MARS), University of Agricultural Sciences, Dharwad during *Kharif 2022* & *Kharif 2023*. The treatments included four different doses of tetraniliprole 200 SC (30, 40, 50 & 100 g ai/ha); Totally five treatments (Table 1) were imposed with four replications. Dimethoate 30 % EC @ 200 gai/ha as standard check with one untreated control. The maize hybrid DKC 9178 was sown with spacing of 60 cm x 20cm. Two sprays were given; first spray was done when pest crossed ETL and second spray was given at 15 days after the first spray using battery operated knapsack sprayer fitted with hallow cone nozzle. Percent incidence of *Chilo partellus* was recorded from 10 randomly selected plants of the crop at three different rows except the boarder rows in each plot at 5 and 10 days after application of insecticides while pre-treatment count was done a day before each spraying. The pest incidence was subjected to arcsine transformation before analysis. Observations were also recorded on the effect of different dosages of tetraniliprole 200 SC (30, 40, 50 & 100 g ai/ha) on natural enemies mainly lady bird beetles (adults & grubs) and spiders at 5 & 10 days after each spray. The yield per plot was recorded and was converted to Kg/ha.

Table 1: Treatment details

Tr. No.	Product	Dosage/ha	
		a.i. (g)	Formulation (ml/ha)
T1	Untreated Control	-	-
T2	Tetraniliprole 200 SC	30	150
T3	Tetraniliprole 200 SC	40	200
T4	Tetraniliprole 200 SC	50	250
T5	Dimethoate 30 EC	200	660
T6	Tetraniliprole 200 SC	100	500

Experimental Results

Kharif- 2022

The data presented in Table 2, evinced that the fifth day after spray, tetraniliprole 200 SC @ 50 gai/ha was found effective in reducing the stem borer population by recording lowest incidence 4.86 per cent, followed by 5.29 per cent in tetraniliprole 200 SC @ 40 gai/ha & 8.11 per cent in tetraniliprole 200 SC @ 30 gai/ha respectively. Similar trend was noticed at 10 DAS. At second spray of 5 DAS, tetraniliprole 200 SC @ 50 gai/ha proved its efficiency by recording least incidence of 8.66 percent. Next best treatments were tetraniliprole 200 SC @ 40 gai/ha (9.56) &tetraniliprole 200 SC @ 30 gai/ha (11.33) respectively. Although, higher dosage (40 & 50 g ai/ha) given good control, tetraniliprole 200 SC @ 30 gai/ha was also found effective throughout the experiment. Similar trend was noticed at 10 DAS. However, high population was sporadically recorded in untreated control plots. Whereas, T4 (tetraniliprole 200 SC @ 50 gai/ha) recorded highest percent reduction over control i.e., 74.39& 90.31 during I^{st}&II^{nd} spray respectively followed by T3, T2 & T5.

Kharif-2023

The fifth day after first spray, tetraniliprole 200 SC @ 50 gai/ha & 40 gai/ha had proved their supremacy by recording least stem borer incidence of 2.77 & 4.11 and both were statistically at par with each other followed by tetraniliprole 200 SC @ 30 gai/ha, which were significantly superior over control. Similar trend was noticed in the efficacy of different treatments at 10 DAS (Table 3). At 5 DAS, tetraniliprole 200 SC @ 50 gai/ha; 40 gai/ha & 30 gai/ha have recorded least percent 7.55, 9.66 & 10.55 incidence, respectively. Similar results were noticed at 10 DAS of second spray. T4 (tetraniliprole 200 SC @ 50 gai/ha) recorded highest percent reduction over control i.e., 73.00& 88.58 during I^{st}&II^{nd} spray respectively followed by T3, T2 & T5.

Natural enemies during *Kharif*-2022 & *Kharif*-2023

All of the treatments were statistically non-significant, based on studies on the effects of tetraniliprole 200 SC on spiders and coccinellids conducted during *Kharif* 2022 and 2023 (Table 4 & 5). This suggests that tetraniliprole 200 SC has no negative effects on the natural enemies in the ecology of maize crops (Table 4&5).

Yield

During *Kharif*-2022& 2023, highest grain yield of 6501 and 6585 kg/ha and cob yield of 8412.00 and 8567 Kg/ha were observed in tetraniliprole 200 SC @ 50 gai/ha& found to be significantly superior over other treatments. The next best treatments were tetraniliprole 200 SC @ 40 gai/ha and tetraniliprole 200 SC @ 30 gai/ha (Table 6).

Tetraniliprole is a potential substitute for traditional insecticides due to its unique method of action, which involves binding and activating ryanodine receptors to deplete intracellular calcium reserves, ultimately causing muscle paralysis and death (Kousika *et al*., 2017). As anthranilic diamides, chlorantraniliprole, cyantraniliprole and tetraniliprole all work by activating the ryanodine receptor (Qi and Casida, 2013). Tetraniliprole is a novel diamide insecticide that is available for usage in the US and China (Neethipudi *et al*., 2020).

The results are in line with Kambrekar *et al*., 2017, tetraniliprole 200 SC @ 0.60 ml/l has recorded 0.72 & 0.52: 0.27 & 0.75 larvae per meter row length at 15 days after first and second spray and seed yield were highest in the treatment with tetraniliprole 200 SC @ 0.60 ml/l with 1623 and 1694 kg/h during 2013-14 and 2014-15, respectively. Babu *et al*., (2016) reported that the highest percentage of semilooper larval mortality was observed in tetraniliprole at 50 and 60 g a. i./ha, followed by tetraniliprole at 40 g a. i./ha. This was comparable to chloranthraniliprole at 30 g a. i./ha three days after the first and second sprays. Tetraniliprole at 50 and 60 g a. i./ha produced the highest mean soybean seed yield in 2013 (19.2-22.0 q/ha) and 2014 (21.2-23.5 q/ha). Until 12 DAE, seed treatment with premix combination insecticides, tetraniliprole + fipronil 240 FS and chlorantraniiprole 625 FS, demonstrated a greatly improved ability to combat fall army worm. The next most effective insecticides were cyantraniliprole + thiamethoxam 19.8 FS and tetraniliprole 480 FS (Suganthi *et al*., 2022).

Conclusion

Tetraniliprole 200 g/L SC @ 30 gai/ha was found to be an efficient way to increase grain and cob yield while decreasing the *Chilo partellus* population in the maize crop. Even though tetraniliprole 200 g/L SC @ 40 and 50 gai/ha has produced good results at higher dosages, smaller dosages that have produced good results can be taken into consideration for subsequent applications.

Table 2: Bio-efficacy of Tetraniliprole 200 (g/l) SC against *Chilo partellus* (% incidence) in maize during *Kharif* -2022

No.	Treatments	Formulation (ml/ha)	Before spray	First spray		% Reduction over control	Second spray		% Reduction over control
				5 DAS	10 DAS		5 DAS	10 DAS	
T1	Untreated Control	-	12.56 (20.76)	19.76 (26.39)	24.76 (29.84)	0.00	30.22 (33.35)	31.44 (34.11)	0.00
T2	Tetraniliprole 200 SC @ 30 gai/ha	150	12.19 (20.43)	8.11 (16.55)	11.34 (19.68)	54.20	11.33 (19.67)	7.64 (17.09)	77.15
T3	Tetraniliprole 200 SC @ 40 gai/ha	200	12.71 (20.89)	5.29 (13.30)	8.56 (17.01)	65.43	9.56 (18.01)	5.12 (14.32)	84.69
T4	Tetraniliprole 200 SC @ 50 gai/ha	250	12.95 (20.93)	4.86 (12.74)	6.34 (14.58)	74.39	8.66 (17.11)	3.24 (10.37)	90.31
T5	Dimethoate 30 EC @ 200 gai/ha	660	12.68 (20.71)	12.55 (20.75)	18.45 (25.44)	25.48	21.03 (27.30)	22.61 (28.39)	32.39
S.Em.±			**NS**	0.20	0.25	-	0.38	1.12	-
C.D. at 5 %				0.68	0.81	-	1.24	3.07	-
C.V. %				7.34	8.56	-	8.11	7.88	-

Figures inside parenthesis are arcsine transformed values
DAS – Days After Spraying

Table 3: Bio-efficacy of Tetraniliprole 200 (g/l) SC against *Chilo partellus* (% incidence) in maize during *Kharif* -2023

No.	Treatments	Formulation (ml/ha)	Before spray	First spray		% Reduction	Second spray		% Reduction
				5 DAS	10 DAS		5 DAS	10 DAS	
T1	Untreated Control	-	11.67 (19.98)	14.79 (22.62)	19.33 (26.08)	0.00	21.55 (27.66)	28.66 (29.77)	0.00
T2	Tetraniliprole 200 SC @ 30 gai/ha	150	11.78 (20.07)	6.21 (14.43)	9.45 (17.90)	51.11	10.55 (18.95)	7.11 (16.78)	76.81
T3	Tetraniliprole 200 SC @ 40 gai/ha	200	11.33 (19.67)	4.11 (11.70)	8.41 (16.86)	56.49	9.66 (18.11)	5.50 (14.31)	82.06
T4	Tetraniliprole 200 SC @ 50 gai/ha	250	11.90 (20.18)	2.77 (9.58)	5.22 (13.21)	73.00	7.55 (15.95)	3.50 (11.54)	88.58
T5	Dimethoate 30 EC @ 200 gai/ha	660	11.55 (19.87)	10.77 (19.16)	14.60 (22.46)	24.47	17.11 (24.43)	18.66 (25.59)	39.14
S.Em.±			**NS**	0.35	0.43	-	0.50	0.55	-
C.D. at 5 %				1.02	1.26	-	1.62	1.74	-
C.V. %				8.63	7.44	-	6.98	7.44	-

Figures inside parenthesis are arcsine transformed values
DAS – Days After Spraying

Table 4: Effect of Tetraniliprole 200 (g/l) SC against ladybird beetles (grub & adult) (numbers/pl) in maize

No.	Treatments	Formulation (ml/ha)	*Kharif* -2022					*Kharif* -2023				
			Before spray	First spray		Second spray		Before spray	First spray		Second spray	
				5 DAS	10 DAS	5 DAS	10 DAS		5 DAS	10 DAS	5 DAS	10 DAS
T1	Untreated Control	-	2.55 (9.19)	2.23 (1.79)	2.45 (1.76)	2.05 (8.23)	2.21 (8.55)	2.23 (1.79)	2.27 (1.77)	2.05 (1.56)	1.87 (1.46)	2.11 (1.73)
T2	Tetraniliprole 200 SC @ 30 gai/ha	150	2.35 (8.82)	2.00 (1.73)	2.03 (1.74)	2.11 (8.35)	2.01 (8.15)	2.11 (1.73)	2.33 (1.68)	2.15 (1.56)	2.00 (1.58)	2.06 (1.57)
T3	Tetraniliprole 200 SC @ 40 gai/ha	200	2.26 (8.65)	1.83 (1.68)	2.14 (1.32)	2.01 (8.15)	2.01 (8.15)	2.11 (1.73)	2.05 (1.56)	2.00 (1.58)	2.05 (1.57)	2.00 (1.58)
T4	Tetraniliprole 200 SC @ 50 gai/ha	250	2.67 (9.40)	2.33 (1.82)	2.10 (1.26)	2.01 (8.15)	2.03 (8.19)	2.33 (1.82)	2.11 (1.56)	2.11 (1.73)	2.21 (1.73)	1.87 (1.46)
T5	Dimethoate 30 EC @ 200 gai/ha	660	2.44 (8.99)	2.37 (1.83)	2.00 (1.60)	2.04 (8.21)	2.01 (8.15)	2.27 (1.43)	2.15 (1.56)	2.00 (1.58)	2.06 (1.57)	2.05 (1.57)
S.Em.±			**0.04**	**0.05**	**0.04**	**0.04**	**0.06**	**0.05**	**0.04**	**0.03**	**0.04**	**0.05**
C.D. at 5 %			**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
C.V. %			**6.33**	**7.22**	**7.56**	**7.89**	**6.45**	**7.47**	**7.88**	**6.56**	**6.98**	**7.04**

NS: Non-Significant

Table 5: Effect of Tetraniliprole 200 (g/l) SC against spiders (numbers/pl) in maize

No.	Treatments	Formulation (ml/ha)	*Kharif* -2022					*Kharif* -2023				
			Before spray	First spray		Second spray		Before spray	First spray		Second spray	
				5 DAS	10 DAS	5 DAS	10 DAS		5 DAS	10 DAS	5 DAS	10 DAS
T1	Untreated Control	-	1.27 (0.94)	1.27 (1.62)	1.08 (0.66)	1.03 (0.56)	1.15 (0.71)	1.38 (1.88)	1.25 (1.49)	1.23 (1.34)	1.21 (1.30)	1.20 (1.23)
T2	Tetraniliprole 200 SC @ 30 gai/ha	150	1.32 (1.12)	1.23 (1.42)	1.02 (0.55)	1.06 (0.62)	1.02 (0.68)	1.31 (1.81)	1.03 (1.42)	1.10 (1.23)	1.21 (1.30)	1.25 (1.06)
T3	Tetraniliprole 200 SC @ 40 gai/ha	200	1.14 (0.90)	1.13 (1.46)	1.02 (0.55)	1.03 (0.57)	1.06 (0.61)	1.30 (1.80)	1.13 (1.46)	1.21 (1.30)	1.20 (1.23)	1.23 (1.34)
T4	Tetraniliprole 200 SC @ 50 gai/ha	250	1.11 (0.84)	1.25 (1.49)	1.02 (0.55)	1.03 (0.57)	1.04 (0.61)	1.33 (1.83)	1.10 (1.44)	1.25 (1.06)	1.23 (1.34)	1.21 (1.30)
T5	Dimethoate 30 EC @ 200 gai/ha	660	1.12 (0.99)	1.10 (1.44)	1.09 (0.68)	1.00 (0.49)	1.04 (0.62)	1.36 (1.86)	1.27 (1.49)	1.20 (1.23)	1.10 (1.23)	1.23 (1.34)
S.Em.±			**0.06**	**0.04**	**0.04**	**0.03**	**0.03**	**0.05**	**0.06**	**0.07**	**0.05**	**0.05**
C.D. at 5 %			**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
C.V. %			**9.42**	**6.45**	**6.77**	**7.82**	**6.77**	**7.44**	**7.33**	**7.77**	**8.34**	**8.01**

NS: Non Significant

Table 6: Effect of Tetraniliprole 200 (g/ l) SC on yield of maize

No.	Treatments	Formulation (ml/ha)	Grain (Kg/ha)				Cob (Kg/ha)	
			2022	% Yield Increment	2023	% Yield Increment	2022	2023
T1	Untreated Control	-	3600	-	3678.00	-	5313.00	5657.00
T2	Tetraniliprole 200 SC @ 30 gai/ha	150	6301	42.87	6378.00	42.33	8245.00	8365.00
T3	Tetraniliprole 200 SC @ 40 gai/ha	200	6378	43.56	6459.00	43.05	8316.00	8438.00
T4	Tetraniliprole 200 SC @ 50 gai/ha	250	6501	44.62	6585.00	44.14	8412.00	8567.00
T5	Dimethoate 30 EC @ 200 gai/ha	660	4602	21.77	4695.00	21.66	6538.00	6685.00
S.Em.±			236.68	-	130.42	-	43.17	30.08
C.D. at 5 %			729.31	-	401.86	-	133.04	92.69
C.V. %			8.46	-	7.56	-	5.45	5.67

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