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RESEARCH ARTICLE

Evaluation of chlorantraniliprole (Coragen 20 SC) against maize stem borers

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ABSTRACT

A field experiment was conducted during *Kharif* 2009 and rabi 2009-10 at Maize Research Centre, Rajendranagar, Hyderabad with the maize hybrid (30V92) in Randomized Block Design with seven treatments for bio-efficacy *i.e.*, coragen 30, 40, 50 and 60 g a.i/ha along with two standard checks, carbaryl 50 WP @ 700 g a.i/ha, endosulfan 35 EC @ 350 g a.i/ha and an untreated control against maize stem borers. Stem borer damage in terms of per cent infestation and per cent dead hearts in four dosages of coragen varied between 1.27 to 2.96 and 0.0 to 0.68 during *Kharif,* 1.06 to 5.60 and 0.0 to 4.31 during *Rabi*. The population of Coccinella spp. remained unaffected.Phytotoxicity symptoms were not noticed on maize crop.

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INTRODUCTION

In India, maize ranks fifth in total area, fourth in production and third in productivity. Among the 250 species of insects and mite species attacking maize in field and storage conditions, spotted stem borer, *Chilo partellus* Swinhoe is the most serious one during *Kharif* causing 26.7-80.4 per cent yield losses in different agro-climatic regions of India (Panwar, 2005). Annual loss of 11.05 crores in *Rabi* is due to the pink borer, *Sesamia inferens* Walker (Siddiqui and Marwaha, 1993). Effectiveness of endosulfan 35 EC spray and whorl application of carbofuran 3G for controlling stem borers was reported by Sajjan (1983). Consequent to the ban of endosulfan, necessity of suggesting alternate chemicals arose. However, no information on new molecules is available. One of the new molecules, Chlorantraniliprole is an anthranilic diamide insecticide with a novel and specific mode of action. It activates ryanodine receptors via stimulation of the release of calcium stores from the sarcoplasmic reticulum of muscle cells causing impaired regulation, paralysis and ultimately death of the sensitive species. It is active on chewing insects primarily by ingestion and secondarily by contact. It has systemic translocation in the plant after soil application and translaminar activity when sprayed. Coragen (Rynaxypyr) has 20 per cent Chlorantraniliprole. Apart from giving long lasting protection (2-3 weeks), it is resistant to photo-degradation, rain fast and harmless to many parasitoids, predators and pollinators. Selectivity to beneficial arthropods makes coragen a strong tool for IPM, where a combination of chemical and biological control techniques is preferred. Reports on the efficacy of coragen on maize stem borer are not available, hence an experiment has been conducted to evaluate the bio-efficacy of coragen 20 SC against maize stem borer apart from its crop safety under field condition, safety against *Coccinella* sp. and finally grain yield.

MATERIALS AND METHODS

A field experiment was conducted at Maize Research Centre, Agricultural Research Institute, Rajendranagar during *Kharif* 2009 and *Rabi* 2009-10 to evaluate the bio-efficacy of Coragen 20 per cent w/v SC against stem borers of maize. Maize hybrid 30 V 92 was grown by adopting all standard package of practices. Experiment was laid out in Randomized Block Design with seven treatments and three replications. Plot size was 27 sq m.

Sr. No	Treatments	Dose (g a.i./ha)	Dose (ml or g/ha)	Sr. No	Treatments	Dose (g a.i./ha)	Dose (ml or g/ha)
1.	Coragen 20 SC	30	150	6*.	Coragen 20 SC	150	750
2.	Coragen 20 SC	40	200	7*.	Coragen 20 SC	180	900
3.	Coragen 20 SC	50	250	8.	Carbaryl 50 WP	700	1400
4.	Coragen 20 SC	60	300	9.	Endosulfan 35 EC	350	1000
5*.	Coragen 20 SC	100	500	10.	Untreated	--	--

* Not for bioeficacy, only for phytotoxicity and residual study

Scale	% Symptoms	Scale	% Symptoms	Scale	% Symptoms
0	0	4	31-40	8	71-80
1	1-10	5	41-50	9	81-90
2	11-20	6	51-60	10	91-100
3	21-30	7	61-70		

Bioefficacy :

The larval count of *Chilo partellus* and *Sesamia inferens* was recorded on ten plants per plot by destructive sampling and data were presented as live larvae per plant. Observations on per cent infestation and per cent dead hearts caused by stem borers were recorded from each plot. Infestation included both dead hearts and plants with leaf injury.

Predator population :

Both grubs and adults of lady bird beetle, *Coccinella septumpunctata* were counted on ten plants per plot and the data were presented on plant basis.

Yield :

The grain yield was recorded plot wise at harvest and presented as kg/plot and t/ha at 15 per cent moisture.

Phytotoxicity :

Seven different dosages of coragen and two check insecticides were sprayed and phytotoxicity on maize plants was assessed by critical visual observation at 1, 3, 7 and 10 days after application for leaf chlorosis, leaf tip burning, necrosis, epinasty, hyponasty, vein clearing, wilting, rosetting and were graded on 0-10 point scale as given below:

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Bioefficacy :

Infestation :

During *Kharif*, lowest stem borer infestation (1.27%) was recorded in the plot treated with coragen 60 g a.i/ha which was on par with the infestation in the plots treated with coragen 50 and 40 g ai/ha. Both the insecticidal checks were similar with respect to infestation (6.82-8.45). Significantly highest infestation (12.89%) was observed in untreated plot. During *Rabi,* coragen 60 and 50 g a.i/ha were significantly similar to each other with 1.06 and 3.20 per cent infestation. Highest infestation of 12.23 per cent was noticed in untreated plot which was at par with the two insecticidal checks (Table 1).

Dead hearts :

All the dosages of coragen were significantly on par with carbaryl in respect of dead heart formation (0 to 1.47%).

Table 1: Efficacy of coragen on stem borer infestation and dead hearts

Sr. No	Treatments	Dose g.a.i./ha	Mean infestation (%)		Mean dead hearts (%)	
			Kharif	*Rabi*	*Kharif*	*Rabi*
T_1	Coragen 20 SC	30	2.96 (9.81)b	5.60 (13.64)bc	0.68 (2.74)ab	4.31(9.81)cd
T_2	Coragen 20 SC	40	1.79 (7.60)ab	4.18 (11.68)bc	0.42 (2.15)ab	1.78(7.64)bc
T_3	Coragen 20 SC	50	1.60 (7.23)a	3.20 (9.66)ab	0.21 (1.52)ab	0.87(4.19)ab
T_4	Coragen 20 SC	60	1.27 (6.31)a	1.06 (4.81)a	0.0 (0.0)a	0.00(0.00)a
T_5	Carbaryl 50 WP	700	6.82 (15.13)c	7.18 (15.51)cd	1.47 (5.54)ab	3.17(10.24)cd
T_6	Endosulfan 35 EC	350	8.45 (16.84)c	7.72(15.98)cd	1.52 (6.85)b	3.96(11.33)cd
T_7	Untreated control	----	12.89(21.01)d	12.23 (20.41)d	5.91 (14.00)c	6.96(15.22)d
C.D.			2.53	5.56	6.63	6.38

Figures in the parentheses are angular transformed values. Means followed by the same letter in a column are not significantly different (P=0.05) from each other using Duncan's Multiple Range Test

Table 2: Efficacy of coragen 20 SC against stem borer larval population

Sr. No.	Treatments	Dose g.a.i./ha	Mean no. / plant			
			Kharif		*Rabi*	
			C. partellus	*S. inferens*	*C. partellus*	*S. inferens*
T_1	Coragen 20 SC	30	0.20 (0.83)a	0.10 (0.77)a	0.13 (0.79)	0.73 (1.11)b
T_2	Coragen 20 SC	40	0.17 (0.82)a	0.07 (0.75)a	0.07 (0.75)	0.23 (0.85)a
T_3	Coragen 20 SC	50	0.07 (0.75)a	0.00 (0.71)a	0.00 (0.71)	0.10 (0.77)a
T_4	Coragen 20 SC	60	0.00 (0.71)a	0.00 (0.71)a	0.00 (0.71)	0.07 (0.75)a
T_5	Carbaryl 50 WP	700	0.67 (1.08)bc	0.03 (0.73)a	0.07 (0.75)	0.60 (1.05)b
T_6	Endosulfan 35 EC	350	0.57 (1.03)b	0.10 (0.77)a	0.07 (0.75)	0.77 (1.12)b
T_7	Untreated Control	----	0.97 (1.21)c	0.33 (0.91)b	0.30 (0.89)	1.77 (1.51)c
C.D.			0.122	0.11	NS	0.113

Figures in the parentheses are square root transformed values. Means followed by the same letter in a column are not significantly different (P=0.05) rom each other using Duncan's Multiple Range Test

Table 3: Impact of coragen 20% SC on *Coccinella septumpunctata* in maize

Sr.No.	Treatments	Dose g.a.i./ha	Mean no. of coccinellids/plant	
			Kharif	*Rabi*
T_1	Coragen 20 SC	30	1.00 (1.20)	0.93 (1.18)
T_2	Coragen 20 SC	40	1.47 (1.39)	1.07 (1.21)
T_3	Coragen 20 SC	50	1.33 (1.34)	1.00 (1.22)
T_4	Coragen 20 SC	60	1.13 (1.27)	1.53 (1.40)
T_5	Carbaryl 50 WP	700	0.80 (1.13)	1.40 (1.37)
T_6	Endosulfan 35 EC	350	1.33 (1.35)	1.53 (1.41)
T_7	Untreated Control	----	1.60 (1.45)	1.33 (1.34)
C.D. @ 5%			NS	NS

Figures in the parentheses are square root transformed values, NS= Non-significant

Table 4: Phytotoxicity of coragen 20 SC at 1, 3, 7 and 10 days after application on maize (*Kharif* and *Rabi* 2009-10)

Sr. No.	Treatments	Dose g a.i/ha	Phytotoxicity parameters							
			(C)	(B)	(N)	(E)	(H)	(VC)	(W)	(R)
1.	Coragen 20 SC	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.	Coragen 20 SC	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.	Coragen 20 SC	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.	Coragen 20 SC	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.	Coragen 20 SC	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.	Coragen 20 SC	150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.	Coragen 20 SC	180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.	Carbaryl 50 WP	700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.	Endosulfan 35 EC	350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.	Control	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Leaf chlorosis (C), leaf tip burning (B), necrosis (N) epinasty (E), hyponasty (H), vein clearing (VC), wilting (W) and rosetting (R)

Table 5: Impact of coragen 20 SC on maize yield

Sr.No	Treatments	Dose (g a.i/ha)	Grain yield at 15% moisture			
			Kharif		*Rabi*	
			(kg/plot)	(t/ha)	(kg/plot)	(t/ha)
T_1	Coragen 20SC	30	13.5 b	4.99	16.67 cd	6.17
T_2	Coragen 20 SC	40	15.3 c	5.67	17.00 cd	6.29
T_3	Coragen 20 SC	50	16.0 c	5.93	17.33 d	6.42
T_4	Coragen 20 SC	60	16.0 c	5.93	17.50 d	6.48
T_5	Carbaryl 50 WP	700	13.3 b	4.93	16.17 bc	5.99
T_6	Endosulfan 35 EC	350	13.2 b	4.89	15.33 ab	5.68
T_7	Untreated control	----	10.9 a	4.04	15.17 a	5.62
C.D.			1.19		0.84	

Means followed by the same letter in a column are not significantly different (P=0.05) from each other using Duncan's Multiple Range Test

Except coragen 60 g ai/ha and untreated control, all other treatments were equally effective in reducing the dead heart formation. During *Rabi* no dead heart formation occurred in coragen 60 g ai/ha whereas 0.87 and 1.78 per cent dead hearts were recorded in 50 and 40 g ai/ha which were significantly similar to each other. Carbaryl and endosulfan were on par with coragen 40 and 30 g ai/ha with respect to dead heart formation. Untreated control had highest per cent dead hearts (6.96).

In *Kharif*, leaf injured plants were more than dead hearts while in *Rabi* dead hearts were more than leaf injured plants (Table 1).

Larval population :

In *Kharif*, larval population of *C.partellus* was significantly similar in all the plots treated with different dosages of coragen. *S.inferens* population was similar in all the treatments except in untreated plot. During *Rabi*, larval population of *C.partellus* in all the plots was not significantly different whereas *S.inferens* population in the three higher doses of coragen was similar (Table 1).

Population of *C.partellus* was comparatively higher during *Kharif* and *S.inferens* was dominant during *Rabi*. Chowdary *et al.* (2010a and b) reported that rynaxypyr @ 30 g a.i/ha and 20 g a.i/ha were superior in recording less larval populations of *H.armigera* and *E.vitella*, lower fruit damage and higher fruit yield in okra. Higher doses of Rynaxypyr @ 75 g a.i/ha applied through root drenching against top borer in sugarcane resulted in 90 per cent reduction in the infestation (Jaipal *et al.,* 2010) and sett soaking with Rynaxypyr @125 g a.i/ha recorded minimum bud damage (14.56%), sett damage, cut end damage due to termites, *Odontotermes obesus* and increased yield in terms of higher germination per cent, more millable canes, height and girth of cane(Rajavel *et al.,* 2009).

Predator population :

No significant differences were observed in the population of coccinellids among the different insecticide treated plots in either of the seasons (Table 2) and impact of coragen *Coccinella septumpunctata* in maize (Table 3).

Phytotoxicity :

Leaf chlorosis, leaf tip burning, necrosis, epinasty, hyponasty, vein clearing, wilting, rosetting were not observed at 1, 3, 7 and 10 days after spraying of seven different doses of coragen in both the seasons (Table 4).

Yield :

During *Kharif*, grain yield obtained in the plots treated with coragen @ 60, 50 and 40 g ai/ha was 16.0, 16.0 and 15.3 kg, respectively which were on par with other. Significantly lowest yield (10.9 kg) was recorded in the untreated plot. Carbaryl and endosulfan were at par with the lowest dose of coragen. During *Rabi*, highest yield of 17.5 kg was recorded in coragen @ 60 g ai/ha but it was significantly on par with all the other dosages. Yield obtained in lower two dosages of coragen was on par with carbaryl (Table 5).

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