International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 1371-1373

Received: 03-03-2018
Accepted: 07-04-2018

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Bio-efficacy of some insecticides for the management of early shoot borer, *Chilo infescatellus* (Snellen) in Sugarcane

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Abstract
Two year (2015-16 and 2016-17) field experiment was conducted in Randomized block design with eight treatments (seven insecticidal treatments and untreated control) and three replications to know the bio-efficacy of some insecticides for the management of early shoot bore, *Chilo infescatellus* (Snellen) in Sugarcane. All the insecticidal treatments recorded significantly less ESB infestation (3.02 to 10.62 %); more NMC (77.62 to 81.17 thousand/ha) and cane yield (87.58 to 98.38 t/ha) as compared to the untreated control (17.05%, 74.69 thousand/ha and 81.25 t/ha, respectively). The chlorantraniliprole 0.4 % GR 22.5 kg/ha followed by fipronil 0.3% GR @ 25 kg/ha both at planting and 60 days after planting found to be the statistically at par and best as they recorded least ESB infestation (3.02 and 3.22 %, respectively) as well as maximum NMC (81.17 and 80.25 thousand/ha) and cane yield (98.38 and 96.84 t/ha). The flubendiamide 39.35% SC @ 125 ml/ha and chlorantraniliorile 18.5% SC @ 375 ml/ha both at 30 and 60 days after planting were statistically at par with each other and the next better treatment in reducing the Early shoot infestation, NMC and cane yield.

Keywords: bio-efficacy, insecticides, chlorantraniliprole, fipronil, early shoot borer, sugarcane

Introduction
Sugarcane (*Saccharum officinarum* L.) is also termed as "Wonder cane" have versatile utility and vast capability to grow in almost all agro-ecological situations, except the extreme ecological conditions. It chiefly utilized in manufacturing of white sugar, bio-fuels, ethanol and cogeneration of electricity and played an important role in socio economical development in rural India. It occupied about 2.57 per cent (5 M ha.) of total cropped area, contributes nearly 10 per cent of agricultural GDP and provides lively hood to about 6 million cane growers (Pathak *et al* 2017) [1]. The crop is affected significantly by biotic factors, it is estimated that losses incurred to be in the tune of 20 per cent in cane yield and 15 per cent in sugar recovery. Although pests are more devastating in subtropics, they often reach serious levels in tropics necessitating development of strategies to maintain them below threshold levels (Ramaraju, 2017) [3]. Early shoot borer, *Chilo infescatellus Snellen* is key pest of sugarcane, distributed all sugarcane growing areas of India. It infests the crop during early growth phase from February to June. If its infestation occur during germination stage, kills the mother shoot resulting drying of whole plant creating gap in the field, while if the attack coincide with the tillering phase the clump does not killed, but the crop stand affected due to mortality of tillers. It is estimated that it can kill mother shoots up to 26 to 95 per cent, primary/secondary tillers up to 6.4 to 27 per cent and tertiary tillers up to 75.0 per cent.
Considering the importance of pest and capacity to incurred losses, an experiment was conducted to study the bio-efficacy of some insecticides to have a chemical, which effectively reduces the early shoot borer in sugarcane.

Material and Methods
The bio-efficacy of some insecticides were tested consecutively for two years 2015-16 and 2016-17 against early shoot bore, *Chilo infescatellus* (Snellen) of sugarcane at All India Coordinated Research Project on Sugarcane, Zonal Agricultural Research Station, Powarkheda, Hoshangabad (MP). The trial encompassed eight treatments i.e., soil application of fipronil 0.3% GR @ 25 kg/ha, chlorantraniliprole 0.4 % GR 22.5 kg/ha, phorate 10% CG @ 15 kg/ha, carbafuran 3% CG @ 33 kg/ha, all at planting and 60 days after planting; spraying of

chlorantraniliorile 18.5% SC @ 375 ml/ha, spinosad 45% SC @ 90 ml/ha and flubendiamide 39.35% M/M SC @ 125 ml/ha at 30 and 60 days after planting and untreated control. Sugacane variety namely CoC 671 was planted and grown with all recommended packages and practices except plant protection measures. The treatments were replicated thrice in plots measured 6.0 x 5.4 m. with a inter row space of 90 cm. The granular insecticides applied at planting and 60 days after planting, while the spray of insecticides (SC formulation) was done at 30 and 60 days after planting. The observations on germination at 45 days after planting, the dead heart counts/meter at 30, 60, 90, and 120 DAP, the diameter (mm), height (cm) and number of millable canes at full grown stage and cane yield were recorded at harvest. The per cent germination, per cent infestation at 30, 60 90 120 DAP and cumulative per cent infestation, NMC/ha, cane yield t/ha calculated. The data so obtained were subjected to randomized block design statistical procedure and presented in table1 and figure 1.

Results and Discussion

The perusal of pooled data for 2015-16 and 2016-17 (table no. 1) revealed that initially at 30 days after planting (DAP) the per cent infestation of ESB is less (0.79 to 2.77%) in treatments of granular application at planting and 60 DAP as compared to other (7.95 to 8.67%). At 60, 90 and 120 DAP; soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha and fipronil 0.3 G @ 25 kg /ha both at 0 and 60 DAP were the best and significantly at par in reducing the ESB infestation, followed by spray flubendiamide 39.35 % SC @ 125 ml/ha and chlorantraniliprole 18.5 SC 375 ml/ha both at 30 and 60 DAP, while the soil application of phorate 10 G @ 15 kg/ha at 0 and 60 DAP, spray of spinosad 45 SC @ 90 ml/ha at 30 and 60 DAP and soil application of carbofuran 3 G @ 33 kg/ha at planting and 60 DAP were intermediate in this respect.

As per the cumulative per cent infestation of ESB (overall effect), all the insecticidal treatments significantly reduced the ESB infestation (3.02 to 10.62 %) as compared to the untreated control (17.05%). The soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha (3.02%) followed by soil application of fipronil 0.3 G @ 25 kg /ha both at planting and 60 DAP (3.22%) found to be the significantly best in reducing the ESB infestation and were significantly at par with each other. The spray of flubendiamide 39.35 % SC @ 125 ml/ha at (5.33%) and spray of chlorantraniliprole 18.5 SC 375 ml/ha both at 30 and 60 DAP (5.53%) were significantly at par with each other and the next better treatment in reducing the ESB. Although, the soil application of phorate 10 G @ 15 kg/ha at 0 and 60 DAP (7.79%) was significantly inferior to the previous treatments but was significantly superior to the spray of spinosad 45 SC @ 90 ml/ha at 30 and 60 DAP (10.10%) and soil application of carbofuran 3 G @ 33 kg/ha at 0 and 60 DAP (10.62%).

In different treatments, the cane diameter (mm) and cane height (cm) ranged in between 25.47 to 26.40 mm and 201.90 to 206.67 cm respectively and differed non-significantly. The insecticidal treatments showed slight numerical superiority in this respect over untreated control.

The insecticidal treatments recorded significantly more NMC (77.62 to 80.25 thousand/ha) and cane yield (87.58 to 98.38t/ha) as compared to untreated control (74.69 thousand/ha and 81.25 t/ha, respectively). The soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha (81.17) followed by soil application of fipronil 0.3 G @ 25 kg /ha both at planting and 60 DAP (80.25) registered significantly maximum NMC, both were significantly at par with each other. The spray of chlorantraniliprole 18.5 SC 375 ml/ha (78.71), spray of flubendiamide 39.35 % SC @ 125 ml/ha both at 30 and 60 DAP (78.40) and soil application of phorate 10 G @ 15 kg/ha at planting and 60 DAP (78.24) were next better performing treatments in this respect; all were significantly at par with each other. While the spray of spinosad 45 SC @ 90 ml/ha at 30 and 60 DAP (77.63) and soil application of carbofuran 3 G @ 33 kg/ha at planting and 60 DAP (77.62) were significantly at par with each other and to the prior three also. In respect of cane yield, the treatments showed the same trend and significances as in NMC. The soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha (98.38 t/ha) followed by soil application of fipronil 0.3 G @ 25 kg /ha both at 0 and 60 DAP (96.84 t/ha) recorded significantly the maximum cane yield, while the spray of chlorantraniliprole 18.5 SC 375 ml/ha (93.36 t/ha), spray of flubendiamide 39.35 % SC @ 125 ml/ha both at 30 and 60 DAP (93.06 t/ha) and soil application of phorate 10 G @ 15 kg/ha at planting and 60 DAP (90.05 t/ha) were intermediate in respect of cane yield recorded.

Our results are in confirmation with the findings of Bhavani *et al* (2017) [4], Badgujar (2017) [5] and Bhavani *et al*. (2017) [4], who found that the soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha at 0 and 60 DAP is best in reducing the ESB infestation and increasing the cane yield in sugarcane. Similarly as ours, the Bhavani *et al*. (2017) [4] also postulated that fipronil 0.3 G @ 25 kg /ha at 0 and 60 DAP is next better insecticidal treatment in controlling the ESB and increasing the cane yield in sugarcane, while Mann *et al.* (2009) [7] found the fipronil was highly toxic against *Chilo infuscatellus* as it reduces the dead hearts by 65%. Sardana (2001) also found fipronil 0.3 G as most effective insecticide in reducing the borer pest in sugarcane and increasing the yield.

Table 1: Bio-efficacy of some insecticides for the effective management of early shoot borer, *Chilo infuscatellus* Snellen in Sugarcane, Powarkheda (M.P.) (polled of 2015-16 & 2016-17)

S. No	Treatments	ESB (%)						Diameter (cm)	Height (cm)	NMC (000'/ha)	Cane Yield (t/ha)	Per cent increase
		Germi. (%)	30 DAP	60 DAP	90 DAP	120 DAP	Cumu-lative					
T1	Soil Application of fipronil 0.3 G @ 25 kg /ha at the time of planting and 60 DAP	76.30	0.87	1.75	1.44	1.46	3.22	26.40	205.90	80.25	96.84	16.10
T2	Soil Application of Chlorantraniliprole 0.4 G @ 22.5 kg /ha at the time of planting and 60 DAP	76.69	0.79	1.59	1.30	1.45	3.02	26.10	205.33	81.17	98.38	17.41
T3	Spray of Chlorantraniliprole 18.5 SC 375 ml/ha at 30 and 60 DAP	75.52	8.67	2.18	2.13	1.68	5.53	25.83	206.67	78.71	93.36	12.98
T4	Spray of spinosad 45 SC @ 90 ml/ha at 30 and 60 DAP	79.17	7.95	3.82	4.57	4.61	10.10	25.86	202.20	77.63	87.66	7.31
T5	Spray of flubendiamide 39.35 % SC @	76.82	8.19	3.73	1.38	1.53	5.33	25.88	202.93	78.40	93.06	12.69

	125 ml/ha at 30 and 60 DAP (50 g a.i./ha)											
T6	Soil Application of phorate 10 G @ 15 kg/ha at the time of planting and 60 DAP (1500g a.i./ha)	77.54	1.74	3.46	2.73	4.54	7.79	25.95	202.45	78.24	90.05	9.77
T7	Soil Application of carbofuran 3 G @ 33 kg/ha at the time of planting and 60 DAP (1000 g a.i./ha)	76.30	2.77	5.00	5.45	5.05	10.62	25.74	202.60	77.62	87.58	7.23
T8	Untreated control	74.74	8.63	10.11	10.34	6.70	17.05	25.47	201.90	74.69	81.25	0.00
S Em ±		1.22	0.34	0.17	0.14	0.13	0.18	0.31	2.44	0.81	1.36	
CD (p=0.05)		NS	0.98	0.49	0.41	0.38	0.52	NS	NS	2.32	3.94	

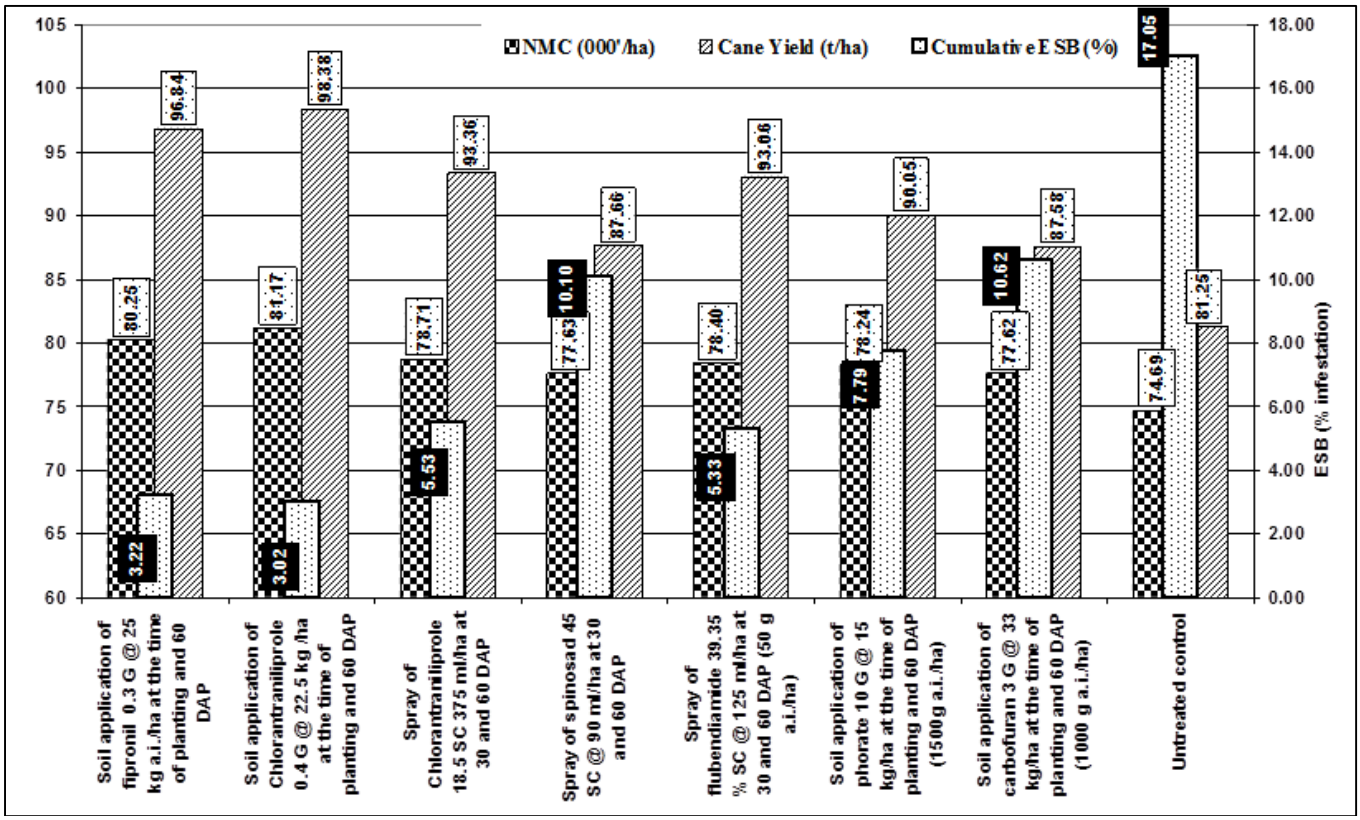

Fig 1: Bio-efficacy of new insecticides for the contral of sugarcane early shoot borer, chilo infuscatellus Snellen, Powarkheda (M.P)

Conclusion

This can be concluded that the soil application of chlorantraniliprole 0.4 G @ 22.5 kg /ha or fipronil 0.3 G @ 25 kg /ha at planting and 60 DAP can recommend for the effective management of ESB in sugarcane.

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