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Bioefficay study of chlorpyriphos 20ec against the Brinjal fruit and shoot borer in Brinjal crop, West Bengal, India

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Abstract
Brinjal fruit and shoot borer (BFSB) is the major biotic threat for brinjal cultivation throughout the globe. It has the potentiality to cause 100% yield loss of brinjal crop if proper management strategies are not taken. The larva is the only damaging stage can cause shoot and fruit damage. Keeping in mind, here the present experiment was conducted to evaluate the efficacy of different concentrations of Chlorpyriphos, a good organophosphate insecticide against this notorious insect pest. From this experiment it is suggested that Chlorpyrifos 20% EC (Megaban) @ 1000 ml/ ha could be recommended to control Brinjal fruit and shoot borer.

Keywords: BFSB, Yield loss, concentrations, chlorpyriphos

Introduction
In India, Production share of Brinjal with 8.3% stands at fourth position among vegetable crops after potato, tomato and onion with 25.5, 11.9 and 11.5 per cent respectively. This crop is regularly and simultaneously attacked by several sucking and chewing insect pests. Among the sucking insect pest profile leafhopper (*Amrasca bigutulla bigutulla* Ishida), whitefly (*Bemisia tabaci* Gennadius) and so far chewing insect pest considered brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee are very important causing huge economic yield loss (Bhadauria *et al*., 1999) [2]. Some of the other reports by the authors regarding loss caused by the brinjal shoot and fruit borer in India and elsewhere. The yield losses caused are as high as 70-92% in India (Rosaiah, 2001) [3] and the pest is reported to cause 3.3-68.9% damage to flowers and 47.6-85.8% damage to fruits in Orissa (Patnaik, 2000) [4]. The management of this pest is through calendar spraying of conventional insecticides irrespective of pest incidence. Insecticides such as bio-pesticides, botanicals and chitin synthesis inhibitors, have been evaluated against *L. orbonalis* in the past (Chatterjee and Roy, 2004, Sharma *et* al., 2004, Mishra and Dash, 2007) [5, 7, 6] and are being used, besides the conventional insecticides. The increased dependence on pesticides, calendar-based sprays by the farmer and short residual action of certain group of insecticides have not only lead to higher costs of production but also have not resulted in adequate control of pest. So far availability of this knowledge, the present experiment was conducted to evaluate the different concentrations of Chlorpyriphos against the BFSB.

Materials and Methods
The present experiment was conducted in Farmers Field in Saguna Village of Nadia District during 2016-2017. The popular and widely cultivated variety named Muktokeshi was selected for this experimental purpose. Six insecticidal treatments with three replications were taken into consideration and statistical analysis was done by randomized block design (RBD). Field bean plants were placed by giving the proper spacing at 80cm x 80 cm and fertilizer was recommended as 200:100:100 (N:P: K) with Farm yard manure @ 25 t / ha. Spraying schedule was fixed for three times during the year 2016-17 and three sprays were done at 10days interval when pest population reached Economic Threshold Level (ETL) level with battery operated knapsack sprayer fitted with hollow cone nozzle with a water volume @ 500 l/ha. Periodic observations were recorded for spotted pod borer incidence before first spray, 4th and 10th days after first, second and third spray. Per cent fruit damage based on number and weight was also recorded on same dates.

Result and Discussion

Three doses of Chlorpyrifos 20% EC (Megaban, the candidate product) @ 750, 1000 and 2000 ml / ha formulation along with Chlorpyrifos 20% EC (Dursban, the marketed product) @ 1000 and 2000 ml / ha were sprayed with an untreated check to work out their efficacy against brinjal fruit and shoot borer. Higher dose i.e. Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha and Chlorpyrifos 20% EC (Dursban) @ 2000 ml / ha were sprayed to also find out the phytotoxic effects on brinjal plant. The first round of spray was done on 18th January, 2017 observing natural infestation of brinjal fruit and shoot borer and subsequently two spraying have been done at 15 days interval on 02nd Februray and 16th March, 2017. The data of the result of 1st, 2nd and 3rd round of the spraying has been presented in the Table-1.

Table 1: Bio-efficacy of different dosages of Insecticides against brinjal fruit and shoot borer after three round of spraying during the season of 2016-17.

Treatment	Dosages (ml/ha)	Mean per cent shoot infestation before spray	1st Spray				2nd Spray			3rd Spray				
			4th day after spray		10th day after spray		4th day after spray		10th day after spray	4th day after spray			10th day after spray	
			Mean per cent shoot infestation	Per cent reduction over control	Mean per cent shoot infestation	Per cent reduction over control	Mean per cent shoot infestation	Per cent reduction over control	Mean per cent shoot infestation	Per cent reduction over control	Mean per cent shoot infestation	Per cent reduction over control	Mean per cent shoot infestation	Per cent reduction over control
T1= Chlorpyrifos 20% EC	750	19.0 (25.8)*	12.3 (20.6)^{b}	43.9	10.0 (18.4)^{c}	63.0	15.7 (23.7)^{c}	51.5	11.7 (20.0)^{bc}	67.9	20.0 (26.6)^{c}	50.8	14.7 (22.5)^{c}	69.0
T2= Chlorpyrifos 20% EC	1000	19.7 (26.3)	10.7 (19.1)^{ab}	51.5	8.3 (16.8)^{ab}	69.1	12.7 (21.3)^{ab}	60.8	10.3 (18.8)^{ab}	71.6	17.7 (24.9)^{a}	56.6	10.7 (19.1)^{a}	77.5
T3= Chlorpyrifos 20% EC*	2000	18.3 (25.4)	9.0 (17.5)^{a}	59.1	7.3 (15.7)^{a}	72.8	11.3 (20.1)^{a}	64.9	9.7 (18.1)^{a}	73.4	17.0 (24.4)^{a}	58.2	9.7 (18.1)^{a}	79.6
T4= Chlorpyrifos 20% EC	1000	19.7 (26.3)	11.3 (19.7)^{ab}	48.5	8.7 (17.1)^{abc}	67.9	13.3 (21.8)^{ab}	58.8	11.0 (19.4)^{abc}	69.7	18.3 (25.4)^{ab}	54.9	11.3 (19.7)^{ab}	76.1
T5= Chlorpyrifos 20% EC*	2000	19.7 (26.3)	10.3 (18.8)^{ab}	53.0	8.0 (16.4)^{ab}	70.4	12.0 (20.7)^{a}	62.9	10.3 (18.8)^{ab}	71.6	17.3 (24.6)^{a}	57.4	10.3 (18.8)^{a}	78.2
T6= Untreated Control	-	19.3 (26.1)	22.0 (28.0)^{c}	--	27.0 (31.3)^{d}	--	32.3 (35.0)^{d}	--	36.3 (37.1)^{d}	--	40.7 (39.6)^{d}	0.0	47.3 (43.5)^{d}	--
F-test		NS	S		S		S		S		S		S	
SEM		0.21	0.77		0.49		0.58		0.43		0.38		0.57	
CD at 5%		0.66	2.37		1.50		1.78		1.33		1.16		1.76	

* Values in the parentheses are angular transformed

Similar alphabets represents the homogeneous means group due to Duncan's Multiple Range Test

Efficacy of Chlorpyrifos 20% EC against brinjal fruit and shoot borer (*Leucinodes orbonalis*)

The efficacy of different treatments schedule against brinjal fruit and shoot borer after 1st, 2nd and 3rd round of spray has been presented in table 2 & 3. The quantum of brinjal fruit and shoot borer infestation was quite uniform before the imposition of first spray. Significant reduction of shoot drooping symptom was noticed in all the treatments over untreated control. But it was observed that out of all tested materials, Chlorpyrifos 20% EC (Megaban) performed better in controlling brinjal fruit and shoot borer than the other marketed products.

After the first spray, among the treatment tested, Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha recorded 9.0 and 7.3 per cent shoot infestation at 4th and 10th days, respectively. On 10th DAS Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha recorded lowest shoot infestation (7.3%), while Chlorpyrifos 20% EC (Megaban) @ 1000 ml / ha, Chlorpyrifos 20% EC (Dursban)1000 ml / ha and 2000 ml / ha also recorded low shoot infestation of 8.3%, 8.7% and 8.0%, respectively which were statistically at par. More or less similar trend of result has been observed and recorded after 2nd and 3rd round of spray. Per cent reduction in shoot and fruit infestation over control showed that all the treatments were effective to control pest incidence. Our experimental findings showed parity with the findings of Sharma *et* al. (2012) [1]. They reported that potential of two botanicals *viz*; ozoneem and neem seed kernel extract (NSKE) and three chemical insecticides *viz*; imidacloprid, alphamathrin, chlorpyriphos 50% EC + cypermethrin 5% EC against *Leucinodes orbonalis* were found very effective.

Table 2: Mean Percentage of fruit infestation by weight caused by *Leucinodes orbonalis* under field conditions.

Treatments		Dosages (ml/ha)	Mean % fruit infestation by weight					
			1st spray		2nd spray		3rd spray	
			4th DAS	10th DAS	4th DAS	10th DAS	4th DAS	10th DAS
T1	Chlorpyrifos 20% EC	750	14.0	10.7	12.2	9.9	13.8	10.2
			(22.0) c*	(19.1) ^{b}	(20.4) ^{b}	(18.4) ^{ab}	(21.8) ^{b}	(18.6) ^{b}
T2	Chlorpyrifos 20% EC	1000	9.5	9.5	11.0	8.1	10.8	8.8
			(17.9) ^{ab}	(17.9) ^{ab}	(19.3) ^{ab}	(16.6) ^{a}	(19.2) ^{ab}	(17.3) ^{ab}
T3	Chlorpyrifos 20% EC*	2000	8.9	8.4	8.9	7.9	9.7	7.8
			(17.3) ^{a}	(16.8) ^{a}	(17.3) ^{a}	(16.4) ^{a}	(18.2) ^{ab}	(16.2) ^{a}
T4	Chlorpyrifos 20% EC	1000	10.6	10.7	11.7	8.6	9.8	9.0
			(19.0) b	(19.1) ^{b}	(20.0) ^{ab}	(17.1) ^{a}	(18.3) ^{ab}	(17.4) ^{ab}
T5	Chlorpyrifos 20% EC*	2000	9.1	9.3	10.7	8.1	8.4	7.9
			(17.6) ^{ab}	(17.7) ^{ab}	(19.1) ^{ab}	(16.5) ^{a}	(16.8) ^{a}	(16.4) ^{a}

T6	Untreated Control	-	30.9	43.5	35.6	51.7	32.7	46.5
			(33.8) [d]	(41.2) [c]	(36.6) [c]	(46.0) [c]	(34.9) [c]	(43.0) [c]
	F-test		S	S	S	S	S	S
	SEM		0.46	0.45	0.91	0.66	1.37	0.42
	CD at 5%		1.43	1.40	2.81	2.02	4.22	1.30

* Values in the parentheses are angular transformed Similar alphabets represents the homogeneous means group due to Duncan's Multiple Range Test

Yield

The mean yield of brinjal plots treated with different insecticides has been presented in table 3 which revealed that the highest yield of 17.46 t/ha was recorded in plot treated with Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha followed by Chlorpyrifos 20% EC (Dursban) @ 2000 ml / ha (17.12 t/ha), Chlorpyrifos 20% EC (Megaban) @ 1000 ml / ha (16.94 t/ha) and Chlorpyrifos 20% EC (Dursban) @ 1000 ml / ha (16.59 t/ha) but were found statistically at par with each other.

Table 3: The yield obtained from different treatments of insecticides after application of three round of spraying

Treatments	Dosage (ml /ha)	Healthy fruit Yield (t/ha)
T1= Chlorpyrifos 20% EC	750	15.74
T2= Chlorpyrifos 20% EC	1000	16.94
T3= Chlorpyrifos 20% EC*	2000	17.46
T4= Chlorpyrifos 20% EC	1000	16.59
T5= Chlorpyrifos 20% EC*	2000	17.12
T6= Untreated Control	-	9.81
SEM		0.10
CD at 5%		0.30

Phytotoxic effects

The phytotoxicity observations summarized in table 4, 5 and 6. The observations (1, 3, 7 10 and 15 days of each spray) clearly indicate that there was no phytotoxicity (0 index i.e. mean no phytotoxicity) symptoms like leaf injury, wilting, epinasty and hyponasty, necrosis, etc. were observed in all the treatments including higher dosages of Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha and Chlorpyrifos 20% EC (Dursban) @ 2000mL/ha. Therefore, Chlorpyrifos 20% EC (Megaban) may be considered as safe to brinjal crop.

Table 4: Studies on phytotoxic effect of different insecticides on brinjal at different days after 1st round of spraying.

Insecticides	Dosage formulation (ml /ha)	Days after 1st round spraying				
		1 DAS	3 DAS	7 DAS	10 DAS	15 DAS
T1= Chlorpyrifos 20% EC	750	0	0	0	0	0
T2= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T3= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T4= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T5= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T6= Untreated Control	-	0	0	0	0	0

DAS = Days after spraying; * Includes Epinasty and Hyponasty, Leaf tips and leaf surface injury, Necrosis, Vein clearing, Wilting etc.

Table 5: Studies on phytotoxic effect of different insecticides on brinjal at different days after 2nd round of spraying.

Insecticides	Dosage formulation (ml /ha)	Days after 1st round spraying				
		1 DAS	3 DAS	7 DAS	10 DAS	15 DAS
T1= Chlorpyrifos 20% EC	750	0	0	0	0	0
T2= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T3= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T4= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T5= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T7= Untreated Control	-	0	0	0	0	0

DAS = Days after spraying; * Includes Epinasty and Hyponasty, Leaf tips and leaf surface injury, Necrosis, Vein clearing, Wilting etc.

Table 6: Studies on phytotoxic effect of different insecticides on brinjal at different days after 3rd round of spraying.

Insecticides	Dosage formulation (ml /ha)	Days after 1st round spraying				
		1 DAS	3 DAS	7 DAS	10 DAS	15 DAS
T1= Chlorpyrifos 20% EC	750	0	0	0	0	0
T2= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T3= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T4= Chlorpyrifos 20% EC	1000	0	0	0	0	0
T5= Chlorpyrifos 20% EC*	2000	0	0	0	0	0
T7= Untreated Control	-	0	0	0	0	0

DAS = Days after spraying; * Includes Epinasty and Hyponasty, Leaf tips and leaf surface injury, Necrosis, Vein clearing, Wilting etc.

Conclusion

From the above mentioned experiment on brinjal it can be concluded that three round of spraying from 18th January, 2017 observing natural infestation of Brinjal fruit and shoot borer at 15 days interval, Chlorpyrifos 20% EC (Megaban) @ 1000 ml / ha and Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha were found to be very effective in controlling Brinjal fruit and shoot borer and recorded higher yield of brinjal than the other treatments and untreated check plots. In addition, there were no phytotoxicity symptoms observed even at the highest dosages of Chlorpyrifos 20% EC (Megaban) @ 2000 ml / ha which indicates that the product is safe to the crop.
Hence, it is suggested that Chlorpyrifos 20% EC (Megaban) @ 1000 ml/ ha could be recommended to control Brinjal fruit and shoot borer

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