J. ent. Res., 36 (2) : 151-155 (2012)

Bioefficacy of insecticides against rice hispa, *Dicladispa armigera* (Olivier) (Coleoptera : Chrysomelidae) on paddy

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ABSTRACT

Cost-benefit-analysis of various treatments revealed that the application of cypermethrin (0.003%) was the most economically viable treatment by recording the highest cost benefit ratio (CBR) of 1: 3.63 followed by fenvalarate (0.003%) (CBR = 1: 3.11).

Key words : Rice hispa, Cachar, bioefficacy, cost-benefit ratio.

Rice (Oryza sativa L.) is the one of the world's leading sources of food among cereals and ranks first position in acreage and total production (Dutta and Barua, 1980). In India, rice is the staple food for about 60% of the total population of the country (Husain, 1996). In Assam it is grown about 70% of the total cultivated land (3.64 million hectares) (Anonymous, 2003). It is mostly cultivated in the low-lying deltas of Brahmmaputra and Barak rivers; some rice is also grown in upland situations in the northern hill region (Islam *et al.* 2004).

Rice crop has relatively a large number of insect pests especially in tropical regions. Since the crop is attacked by pests right from the time of sowing till it is harvested, inadequate crop protection in India has been causing an annual loss to the time of nearly 36% by insect pests alone (Verma and Gupta, 2001). Thirteen major insect infestations has been reported by systematic surveys in different regions of the state (Barwal *et al.* 1994; Dutta and Hazarika, 1994). Out of the various insect pests of paddy, rice hispa, *Dicladispa armigera* (Olivier) (Coleoptera: Chrysomelidae) considered as a major pest in this region. This pest causes extensive damage to the vegetative stage of plant resulting 35-65% loss in yield throughout Assam (Rajek *et al.* 1986; Hazarika and Dutta, 1991; Dutta and Hazarika, 1992). It is an important potential insect pest of the state, which is endemic in Sibsagar, Lakhimpur, Nalbari, Borpeta, Cachar and Karimganj districts (Islam *et al.* 2004). For the management of the pest chemical insecticides have been used since long back by the local farmers of the valley, though no literature is available from the valley so far. Hence, efforts were made to recognize the best insecticide on the basis of mortality and economic viability amongst different conventional chemical insecticides against the pest.

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MATERIALS AND METHODS

The present investigation was conducted in Dargakona (Cachar district) near Assam University, Silchar, Assam, India (latitude 24º41´29.9˝ N, longitude 92º45´25.9˝ E, altitude 36 m a.s.l.). The experiment was conducted in a randomized block design (RBD) to measure the bio-efficacy of different chemical pesticides in terms of mortality of the pest. Nine chemical insecticides including six organophosphates viz., Quinalphos (25 EC), Malathion (50 EC), Dimethoate (30 EC), Phosphamidon (40 SL), Chlorpyriphos (20 EC) & Monocrotophos (36 SL); one organochlorine viz., Endosulfan (35 EC) and two pyrethroids viz., Cypermethrin (10 EC) & Fenvalarate (20 EC) were evaluated against *D. armigera* in the field conditions in two concentrations. Treatments were applied at farmers' field in Dargakona village. Five replications were followed for each treatment and each replication consists of four hills (25 cm × 25 cm area). Control (water spray) was also run against treatment. The percent mortality of the hispa beetles was recorded after 24 h of exposure. Percent reduction was calculated following Abbott's (1925) formula. Cost-Benefit Analysis of different insecticides was measured to check the economic viability of the treatments.

RESULTS AND DISCUSSION

Bio-efficacy of chemical insecticides against *D. armigera* revealed that quinalphos 0.025% concentration showed 73.08% reduction at 1st day after treatment (DATr). At 5DATr percent reduction decreased to 24.36%. Quinalphos 0.05% concentration showed higher percent reduction than 0.025% conc. At 1DATr 0.05% conc. showed 85.89% reduction whether maximum reduction (97.43%) found at 15DATr. Malathion 0.025% showed 46.73% mortality on 1DATr and maximum mortality (96.26%) at 15DATr. Malathion 0.05% showed 65.42% mortality on 1DATr and maximum mortality (99.06%) at 15DATr. Dimethoate 0.025% conc. showed 46.79% reduction at 1DATr and maximum reduction (94.49%) were found on 10DATr and 15DATr. Higher concentrations (0.05%) showed 66.97% reduction at 1DATr and maximum reduction (99.08%) at 15DATr. Phosphamidon 0.025% conc. showed 38.67% reduction at 1DATr whether 72.0% reduction was found at 15DATr. In case of 0.05% conc. 78.67% reduction was found at 1DATr and 93.33% reduction was found at 10DATr and 15DATr. Endosulfan showed 87.88% reduction at 1DATr in 0.025% conc. and cent percent reduction at 15DATr. Higher conc. (0.05%) also showed 87.88% reduction at 1DATr. whereas cent percent reduction at 10DATr. Chlorpyriphos 0.025% showed 51.28% reduction at 1DATr. and cent percent reduction at 15DATr. In case of higher conc. (0.05%) 77.98%reduction was found at 1DATr. and cent percent reduction at 10DATr. In lower conc. (0.001%) monocrotophos showed 93.88% reduction at 1DATr. and cent percent reduction at 15DATr. In case of higher conc. (0.003%) 95.92% reduction at 1DATr. and cent percent reduction at 10DATr. Cypermethrin 0.001% conc. showed 87.10% reduction at 1DATr. and cent percent reduction at 5DATr. Higher conc. (0.003%) showed 93.55% reduction at 1DATr. and cent percent reduction at 5DATr. Fenvalarate showed 82.76% reduction at 1DATr. with 0.001 conc. and cent percent reduction at 5DATr. Higher conc. (0.003%) showed 93.10% reduction at 1DATr. and cent percent reduction at 5DATr.

Duncan's Multiple Range Test (DMRT) revealed that percent reductions of different treatments are significantly different on 1st, 10th and 15th days after treatments.

Data revealed that higher concentrations showed more efficacy than lower concentrations in each treatment. Highest bio-efficacy (95.92%) was found in case of monocrotophos (0.003%) followed by 93.88% with monocrotophos 0.001% conc. at 1DATr. Cypermethrin and Fenvalarate showed cent percent reduction of the pest at 5DATr. in both concentrations. Both the treatments showed quick-knock-down of the pest followed by monocrotophos. Whereas quinalphos 0.025% and phosphamidon 0.025% found to be less effective as compared to the other treatments (Table 1). The control of *D. armigera* with both systemic and non-systemic insecticides has been reported by several workers from India (Agarwala, 1955; Israel and Prakasa Rao 1969; Dhaliwal *et al.* 1977; Subbaratnam and Perraju 1978; Budhraja *et al.* 1979 and 1980; Dhaliwal and Singh 1979; Krishnaiah and Kalode 1983; Singh *et al.* 1984; Krishnaiah *et al.* 1987; Dhaliwal and Singh 1988; Singh *et al.* 1984 and 1992) and abroad (Kabir and Mia 1976; Zafar 1984).

Dhaliwal and Singh (1979) evaluated carbaryl, dicrotophos, fenitrothion, monocrotophos, phosalone and methylcarbamate in different concentrations and was found phosalone to be quite effective. Monocrotophos was also effective but showed less persistence than phosalone. Budhraja *et al.* (1980) reported that quinalphos showed the most rapid quick-knock-down effect with 100% mortality after 24 hr but lost its effectiveness after five days followed by phosphamidon and phosalone with persistence upto 5 days. Monocrotophos, methyl demeton and methyl parathion appeared more persistent insecticides which showed toxicity upto 10 days which highly supports our findings. Krishnaiah and Kalode (1983) mentioned that carbofuran, phosalone, fenthion and chlorpyriphos showed quick knock-down effect, though quinalphos, fenthion and chlorpyriphos were also effective against mining pupae.

Krishnaiah *et al.* (1987) evaluated eight insecticides against *D. armigera* which proved that monocrotophos at 0.06% was most effective against hispa grubs, followed by quinalphos at 0.07%. Adult beetle population was also checked by monocrotophos followed by quinalphos that partially supports our findings. Dhaliwal and Singh (1988) reported that sprays of fenvalerate and isofenphos were effective in reducing both its larval population and damages to the leaves. In addition, monocrotophos was also effective against its larvae. Singh *et al.* (1992) evaluated fenvalerate, cypermethrin and monocrotophos against rice hispa which proved effective with increasing grain yield over untreated control, which are concurrent to our observations.

Table 1. Bio-efficacy of some chemical insecticides against *D. armigera* on paddy.

Treatments	Concentrations (%)	Percent reduction at days after treatments+			
		1DATr.	5DATr.	10 DATr.	15 DATr.
Quinalphos	0.025	73.08 (58.26)cd	24.36 (29.36)	51.28 (45.29)d	50.0 (44.48)e
25 EC	0.05	85.89 (67.02)abc	89.74 (70.17)	91.02 (71.88)b	97.43 (78.73)b
Malathion	0.025	46.73 (42.95)f	85.05 (66.96)	90.65 (71.84)b	96.26 (78.55)b
50 EC	0.05	65.42 (53.22)de	81.31 (64.18)	92.52 (73.78)b	99.06 (82.11)b
Dimethoate	0.025	46.79 (42.88)f	65.14 (53.20)	94.49 (75.98)b	94.49 (75.98)b
30 EC	0.05	66.97 (54.18)de	77.98 (61.68)	94.49 (75.98)b	99.08 (82.11)b
Phosphamidon	0.025	38.67 (37.60)f	68.0 (55.13)	70.66 (57.15)c	72.0 (57.23)d
40 SL	0.05	78.67 (61.73)bcd	76.0 (60.48)	93.33 (73.86)b	93.33 (73.86)c
Endosulfan	0.025	87.88 (68.55)ab	93.94 (73.93)	96.97 (78.66)b	100.0 (90.0)a
35 EC	0.05	87.88 (68.55)ab	96.97 (78.66)	100.0 (90.0)a	100.0 (90.0)a
Chlorpyriphos	0.025	51.28 (45.29)ef	65.15 (53.14)	81.31 (64.18)c	100.0 (90.0)a
20 EC	0.05	77.98 (61.68)bc	90.65 (71.84)	100.0 (90.0)a	100.0 (90.0)a
Monocrotophos	0.001	93.88 (73.92)a	93.88 (73.92)	95.92 (76.15)b	100.0 (90.0)a
36 SL	0.003	95.92 (76.15)a	93.88 (73.92)	100.0 (90.0)a	100.0 (90.0)a
Cypermethrin	0.001	87.10 (68.48)ab	100.0 (90.0)	100.0 (90.0)a	100.0 (90.0)a
10 EC	0.003	93.55 (73.89)a	100.0 (90.0)	100.0 (90.0)a	100.0 (90.0)a
Fenvalarate	0.001	82.76 (64.29)b	100.0 (90.0)	100.0 (90.0)a	100.0 (90.0)a
20 EC	0.003	93.10 (73.84)a	100.0 (90.0)	100.0 (90.0)a	100.0 (90.0)a
Control (water spray)	0.0	15.0 (22.38)g	6.6 (14.53)	6.2 (13.94)e	5.2 (12.76)f
CD at 5%	-	9.46*	3.24 (NS)	7.74*	6.80*

*Significant ($p < 0.05$), NS = Non Significant, DATr. = Date after treatments. + Based on 5 replications, each consists of 4 hills (25 cm × 25 cm). Figures in the parentheses are average of transformed values = Arc sin $\sqrt{\text{percentage}}$. In a column, means followed by a common letter are not significantly different ($p < 0.05$) by DMRT.

Table 2. Economics of different insecticides in paddy.

Treatments	Concentrations (%)	Total grain yield (q ha^{-1})	Grain yield increased over control (%)	Net profit* (Rs. / ha)	Cost benefitratio (C : B)
Quinalphos 25 EC	0.05	13.98	34.03	1029.00	1:1.54
Malathion 50 EC	0.05	14.02	34.42	1038.20	1:1.51
Dimethoate 30 EC	0.05	13.86	32.88	911.40	1:1.24
Phosphamidon 40 SL	0.05	14.25	36.62	1111.60	1:1.54
Endosulfan 35 EC	0.05	14.80	41.89	1392.60	1:1.97
Chlorpyriphos 20 EC	0.05	15.12	44.96	1621.20	1:2.57
Monocrotophos 36 SL	0.003	14.17	35.86	1155.20	1:1.80
Cypermethrin 10 EC	0.003	16.36	56.85	2231.40	1:3.63
Fenvalarate 20 EC	0.003	15.95	52.92	2004.60	1:3.11
Control (water spray)	0.0	10.43	-	-	-

*Cost of insecticides and sale price of rice were considered as per local markets of Silchar (Assam).

Cost-Benefit-Analysis of different chemical insecticides : Data obtained on the cost-benefit-analysis of various treatments revealed that the application of Cypermethrin (0.003%) was the most economically viable treatment by recording the highest Cost Benefit Ratio (CBR) of 1 : 3.63 followed by Fenvalarate (0.003%) (CBR = 1 : 3.11). The reasons for the treatments economic viability was the fact that the treatments recorded the maximum yield and secondly the cost of treatments inputs was low compared to the others. The CBR in the descending order was Cypermethrin (1 : 3.63) > Fenvalarate (1 : 3.11) > Chlorpyriphos (1 : 2.57) > Endosulfan (1 : 1.97) > Monocrotophos (1 : 1.80) > Phosphamidon (1 : 1.54) > Quinalphos (1 : 1.54) > Malathion (1 : 1.51) > Dimethoate (1 : 1.24) (Table 2).

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(Accepted : April 10, 2012)