https://doi.org/10.29321/MAJ.10.A02659

Madras agric J 70 (4) 595—602 September 1983

SCREENING OF INSECTICIDES AGAINST THE NYMPHS AND ADULTS OF NILAPARVATA LUGENS STAL, THE RICE BROWN PLANTHOPPER*

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Twelve commercial insecticides in emulsifiable concentrates and wettable powder forms at four concentrations *Viz.*, 0.025, 0.05, 0.075 and 0.10% a.i were evaluated in bioassay studies against adults and nymphs of brown planthopper (BPH) separately. Diazinon 0.05% a.i concentration was taken as standard. The efficacy and persistence of all other test insecticides were compared with this standard. Fresh lots of insects were released/caged periodically to find out the persistent toxicity of respective insecticides. Considering the overall persistent toxicity against adults and nymphs based on 'PT' values and overall mean persistent toxicity, chlorpyrifos and carbofuran 0.05% a.i as foliar sprays followed by quinalphos and monocrotophos are the most effective in the control of BPH in the field.

The brown planthopper (BPH), *Nilaparvata lugens* stal since 1970, has become a major pest in several parts of Indian Sub-Contingent, as also in other rice-growing Countries of Asia (Dyck, 1977; Rao, 1978). *N. lugens* caused direct damage to plants by sucking sap of the plants as well as transmitting 'grassy stunt' virus disease (Ling, 1968), so much so two fold reduction in paddy yields are noticed.

Effective control measures to combat this pest are very much needed. Hence, trials were initiated to screen out effective and persistent insecticides for controlling the pest. The results obtained from these trials are presented in this paper.

MATERIALS AND METHODS

Two experiments, one against the adults and the other against the nymphs during the year 1976-1977 were carried out. In both the experiments one month old paddy plants (var. *Jaya*) grown in earthenware pots were used as test plants. Twelve commercial insecticides in emulsifiable and wettable powder forms at four different concentrations viz., 0.025, 0.05, 0.075 and 0.10% a. I (Table 1 and 2) were evaluated separately against adults and nymphs. The plants were sprayed with an atomizer upto run-off stage taking adequate precautions to prevent the insecticides from falling on the soil surface of the pot. Sprayed plants were air dried under laboratory conditions for 24

*Part of the Ph. D thesis submitted by the senior author to the Orissa University of Agriculture and Technology, Bhubaneswar.

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hours. One day after spraying, ten healthy adults of BPH or ten healthy 3rd instar nymphs of BPH as the case may be were caged separately on the treated plants. Insect releases were made at 1,3,5,8,11,14,17 and 20 days after treatment (DAT) for both adults and nymphs. The experiment was replicated thrice including control. For the tests on persistency. The sprayed plants were uncaged after each test was completed and left exposed to the weather, until such time when they were ready for retesting. In each test, fresh planthoppers were used. For each test the number of dead planthoppers was recorded at the end of 24 hours after insect release. Apparently moribund insects were counted as dead. Mortality in control was adjusted by using the formula suggested by Abbot (1925).

RESULTS AND DISCUSSION

The dta on mortality of adults and nymphs for 24 hours on the treated plants are presented in Table 1 and 2 respectively. *Against BPH adults.* Diazinon, chlorpyifos and monocrotophos at 0.05% a.i and above concentrations and all the four concentrations of endrin, chlorfenvinphos, carbofuran, carbary1 quinalphos and phosphamidon have resulted in 100% kill of the test insect on one day old residues. Out of the test insecticides, only chlorpyrifos resulted in more than 70% of kill at all four concentrations even after eight days of treatment. However, chlorphyrifos lost its persistent toxicity between 14 to 17 days after treatment at all four concentrations, while carbofuran recorded more than 60% of kill at 0.05% concentration and above at 11th day after treatment and continued to show some persistent toxicity upto 14thday after treatment. The other insecticides viz., diazinon, endrin, chlorfenvinphos, carbaryl, quinalphos and monocrotophos at certain concentrations gave more than 50% of kill the test insect at five days after treatment. However, all these insecticides lost completely persistent toxicity between 11 to 14 days after treatment. Endosulfan and mephosfolan are ineffective. 0.05% of diazinon was taken as standard and compared the persistent toxicity of other insecticides with this standard.

The data was analysed through 'PT' values (Saini, 1959) and by CRD method for both adults and nymphs. As per 'PT' values, carbofuran, chlorpyrifos, quinalphos, carbaryl, monocrotophos and phosphamidon were grouped as superior to 0.05% of diazinon, while lindane, endrin, mephosfolan and endosulfan were ineffective, Chlorfenvinphos was on par in persistency to that of 0.05% of diazinon. A perusal of statistical analysis showed that insecticides found significantly superior, or on par or inferior to diazinon followed exactly the same order as reflected by 'PT' values. The difference in treatment means were statistically significant in respect of insecticides, doses and insecticides x doses. Increasing doses resulted in highly significant increase in persistent toxicity. Interaction between insecticides and doses was highly significant.

Though many insecticidal treatments were significantly superior at lower doses as compared to either 0.05% a.i or 0.10% a.i diazinon, it was significant that chloryprifos at 0.025% a.i. and above, carbofuran at 0.05% a.i and above and quinalphos at 0.075% a.i and above were superior to diazinon 0.10% a.i. Carbaryl, quinalphos and monocrotophos at 0.05% a.i were also on par with 0.10% a.i diazinon. Besed on these results, chlorpyrifos 0.025 to 0.05% a.i, carbofuran, quinalphos, carbaryl and monocrotophos 0.05% a.i as foliiiar sprays are identified as the most effective treatments against adults.

Against BPH nymphs:

As in the case of adults, less than 50% mortality (20.0 to 40.0) was racorded in 0.025 and 0.05% a.i concentrations of endosulfan and mephosfolan, while the two higher doses viz, 0.075 and 0.10% a i concentrations of these two insecticides and all four concentrations on the rest of the 10 candidate insecticides resulted in more than 50% mortality (50.0 to 100 0) one day after treatment (Table 2). More than 50% mortality 56.6 to 83.3%) was recorded even 11 days after treatment with carbofuran at 0 05 to 0.10% a.i concentrations, followed by chlorpyrifos, wherein, more than 50% mortality)53 3 to 100%) at 0.025 to 0.10% a i concentrations was recorded at 8 days after treatment. As in the case of adults, endosulfan and mephosfolan were ineffective and showed less than 50% mortality at all concentrations at 3 days after treatment By and large the persistence of all the test insecticides were lost earlier in case of nymphs compared to adults. A perusal of data reveal that mortality in case of adults was somewhat more than nymphs at different concentrations and at different days of test.

The 'PT' values and analysis of variance reveal that carbofuran, chlorpyrifos quinalphos, monocrotophos and carbaryl were superior to 0.05% a.i concentration of diazinon, while chlorfenvinphos, lindane endrin, endosulfan and mephosfolan were inferior. Phosphamidon was on par with 0.05% a.i concentration of diazinon. The differences in treatment means were statistically significant in respect of insecticides, doses and inescticides x doses. Increasing doses resulted in highly significant increase in persistent toxicity. Interaction between insecticides and doses was highly significant. Chlorpyrifos and carbofuran 0.05% a.i were significantly superior and chlorpyrifos 0.025% a.i, quinalphos and monocrotophos at 0.05% a.i were on par with 0.10% a.i diazinon against nymphs.

Taking the persistent toxicity of the insecticides against both adults and nymphs together into consideration, endosulfan and mephosfolan were only 0.3 times as toxic as diaxinon and hence considered as ineffective. Endrin lindane, chlorfenvinphos, phosphamidon, monocrotophos and carbary. were 0.8 to 1.2 times as toxic as diazinon while quinalphos was 1.4 times as toxic Chlorpyrifos and carbofuran were outstanding with 1.8 and 2.0 times respectively as toxic as diazinon.

Carbaryl, diazinon and endrin (Israel *et al.*, 1968). from laboratory studies, phosphamidon and monocrot. phos (Chelliah and Subramaniam 1972-73) Carbaryl (Das *et al.*, 1972-73) endrin, quinalphos and monocrotophos (Mani.1976) and carbofuran and diazinon (Rao *et al* , 1976) from field studies were reported effective against BPH from India. Carbaryl (Nakasuji and Kiritani, 1974), from field studies, in Japan, monocrotophos, carbaryl carbofuran. chlorpyrifos and quinalphos from field and green house studies at IRRI Insecticide Evaluation Results 1976, IRRI) were reported effective against BPH Carbaryl, monocrotophos. phosphamidon, diazinon and endrin were also reported effective from some other Countries also Heong, 1975; Hinckley. 1963; Lim 1971.singh,1975)

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TABLE 1 : Relative effectiveness and persistence of different concentrations of some insecticides applied as foliar sprays against BPH adults exposed for 24 hours.

Insecticides	Concen-tration % a.i.	%corrected mortality/age of residue 1	3	6	8	11	14	17	20	'PT' value angular Values
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Diazinon	0.025	93.3	53.3	43.3	0	0				351/31.38
	0 05	100.0	90.0	56 6	16.6	0				622/35.54
	0.075	100.0	100.0	86 6	30.0	0				667/42 24
	0.10	100.0	100.0	96.6	30.0	0				682/43.47
Endrin	0 025	100.0	30.0	23.3	6.6	0				288/28.54
	0.05	100.0	46.6	30.0	6.6	0				338/30.73
	0.075	100.0	76.6	63.3	26.6	0				542/30.08
	0.10	100.0	100 0	83.3	33 3	0				658/41.97
Chlorfenvinphos	0.025	100 0	33.3	20.0	13 3	0				307/29.16
	0.05	100 0	60.0	46.6	40.0	20.0	0			567/38.08
	0.075	100.0	63.3	50.0	46.6	23 3	0			603/39 50
	0.10	100.0	93.3	70.0	46 6	26.6	0			732/43.91
Chlorpyrifos	0.025	93 3	100.0	90 0	79 3	30.0	0			833/48 56
	0.05	100.0	100.0	100.0	100 0	43.3	0	0		1030/52.76
	0.075	10,00	100.0	100.0	100.0	50 0	13 3	0		1090/54.39
	0.10	100.0	100.0	100.0	100.0	63.3	20.0	0		1150/56 16
Carbofuran	0 025	100 0	86.6	50.0	43 3	0	0	0 0		578/38.66
	0.05	100.0	100.0	100 0	93.3	60.0	20.0	10 00		1150/56.34
	0.075	100.0	100.0	100.0	100 0	83 0	36.6	23.30		1330/61.82
	0.10	1009.	100 0	100.0	100.0	90.0	76.6	40 00		1520/68.56
Carbaryl	0.025	100.0	53 3	30.0	26.6	6	0	0		398/33.22
	0.05	100 0	80.0	46 6	40.0	16 6	0	0		568/39.50
	0 075	100 0	100.0	90.0	66.6	20.0	0	0		792/46 61
	0.10	100.0	100 0	100.0	80.0	40.0	40.0	0		1020/54.16

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Quinalphos	0.025	100.0	70.0	46.6	16.6	0	0	0		456/35.28
	0.05	100'0	100 0	100.0	43.3	0	0	0		730/44.48
	0.075	100 0	100.0	100.0	63.3	23.3	0	0		880/48.03
	0.10	100.0	100.0	100 0	70.0	36.6	0	0		917/49.08
Monocrotophos	0 025	93.3	63 3	50.0	26.6	0	0			472/35.23
	0.05	100.0	100.0	70.0	40.0	0	0			645/41.59
	0.075	100.0	100.0	86.6	46.6	20.0	0			767/46.29
	0.10	100.0	100.0	93 3	46.6	33.3	0			817.46.91
Phosphamidon	0.025	100.0	50.0	30 0	0	0	0			320/37.08
	0.05	100.0	76 6	60.0	26.6	0	0			533/37.86
	0.075	100.0	100.0	90.0	40.0	20.0	0			752/43.36
	0.10	100.0	100.0	100.0	56.6	33.3	0			870/47.70
Lindane	0.025	53.3	26.6	20.0	6.6	0	0	0		200/22.84
	0 05	80.0	60 0	43 3	20.0	6.6	0	0		419/33.06
	0.075	100.0	73 3	63.3	20 0	20.0	20.0	0		636/40.63
	0.10	100.0	90.0	76 6	33.3	30.0	36.6	0		823/46.91
Endosulfan	0.025	16.6	0	0	0	0				25/8 81
	0.05	33.3	13.3	0	0	0				77/14.98
	0.075	63.3	40.0	20.0	0	0				255/24.79
	0.10	76.6	63.3	30 0	6.6	0				336/35.32
Mephosfolan	0.025	30.0	0	0	0	0				45/12.58
	0.05	33.3	13 3	6.6	0	0				91/15.29
	0.075	60.0	26.6	20.0	20.0	0				243/24 72
	0 10	66.6	46.6	30.0	16.6	0				318/28.56
%range mortality in control		0	0	0	0	3.3	0	0		

C.D. to compare doses (0.05)=1.19 (0.10)=1.58
C.D. to compare insecticides (0.05)=2.06 (0.10)=2.73
C.D. to compare insecticides X doses (005)=4.12 (0.10)=5.46)

TABLE 2 : Relative effectiveness and persistence of different concentrations of some insecticides applied as foliar sprays against BPH nymps exposed for 24 hours.

nsecticides	Concentration % a.i.	% corrected mortality/age of residue indays 1	3	6	8	11	14	17	20	'PT' value angular Values
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Diazinon	0,025	83.3	53.3	34.4	0	0				318/29.4
	0.05	100.0	83.3	51.7	20.0	0				496/37.15
	0.075	100.0	100.0	75.8	33.3	0				641/41.64
	0.10	100.0	100.0	82.7	40.0	0				677/42.78
Endrin	0 025	100.0	23.3	20.6	10.0	0				278/27.94
	0.05	100.0	33.3	27.6	10.0	0	0			317/29.29
	0.075	100.0	60.0	51.7	13.3	6.6	0			452/35.06
	0.10	100.0	83.3	62.0	16 6	13.3	0			561/38.82
Chlorfenvinphos	0,025	80 0	36.6	33.3	0	0				276/20.56
	0.05	93 3	60.0	43.3	16.6	0				398/32.59
	0.075	100.0	63.3	56.6	36,6	0				628/37.18
	0,10	100.0	90.0	76,6	36 6	0				631/41.17
Chlorpyrifos	0,025	100 0	100.0	82.1	53.3	30.0	0			806/46.28
	0.05	100,0	100.0	92.8	90 0	33.3	0			952/50.48
	0.075	100,0	100.0	96.3	93.3	46.6	0			1011/53.65
	0.10	100.0	100 0	100.0	100 0	50.0	0			1050/53.98
Carbofuran	0 025	100 0	76 6	53.3	20 0	0	0	0	0	496/38.70
	0,05	100,0	100.0	100.0	76,6	56.6	0	0	0	899/51.90
	0.075	100.0	100.0	100.0	100.0	83 3	20.0	13.3	0	1273/59.25
	0.10	100.0	100 0	100.0	100.0	83.3	60.0	23.3	0	1398/64.11
Carbaryl	0.025	100.0	46 6	33.3	0	0	0	0		327/30.81
	0.05	100 0	73.3	60.0	26.6	3.3	0	0		463/37.44
	0.075	100 0	100.0	90.0	40.0	10.0	0	0		706/44.18
	0.10	100.0	100 0	100.0	66.6	63.3	26.6	0		1019/53.27

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Quinalphos	0.025	100.0	73.3	63.3	13.3	0	0			470/35.85
	0.05	100.0	100 0	100.0	50.0	0	0			750/45.00
	0.075	100 0	100.0	100.0	63.3	20.0	0			850/47.74
	0.10	100.0	100 0	100.0	66.6	26.6	0			880/48.66
Monocrotophos	0.025	100.0	63 3	53.3	30.0	0	0			498/36.11
	0.05	100.0	90.0	76.6	30.0	0	0			612/40.61
	0.075	100.0	100.0	83.3	36.6	23.3	0			737/44.44
	0.10	100.0	100.0	90 0	40.0	26.6	0			776.45.53
Phosphamidon	0.025	100.0	46.6	0	0	0	0			243/27.23
	0 05	100.0	70 0	66.6	30.0	0	0			521/37.26
	0.075	100.0	100.0	70.0	46.6	0	0			665/42.27
	0.10	100.0	100 0	100 0	63.3	46.6	0			930/49.93
Lindane	0.025	60.0	30.0	16.6	0	0	0	0		192/22 86
	0.05	76.6	43 3	36 6	0	0	0	0		294/28.16
	0.075	100.0	70 0	63.3	16 6	20.0	6.6	0		578/38.98
	0.10	100.0	83.3	66 6	30.0	26.6	10.0	0		783/48.94
Endosulfan	0.025	20.0	0	0	0					30/9.98
	0.05	40.0	0	0	0					60/13.66
	0.075	76 6	26.6	20.0	0					218/24.75
	0.10	80.0	33.3	23.3	0					245/26 12
Mephnosfolan	0.025	30.0	10.0	6.6	0					75/14.29
	0.05	40.0	16 6	6.6	0					103/16.98
	0.075	50.0	30.0	6.6	0					146/20 57
	0 10	53.3	43.3	23.3	0					200/24.39
% range mortality in control		0	0	6.6	0	0	0	0		

C.D. to compare doses (0.05)=1.23 C.D. to compare to insecticides (0.05)=2.14
(0.10)=1.63 (0.10)=2.84
C.D. to compare Insecticides X doses (005)=4.30 (0.10)=5.68