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EFFECTIVENESS OF SOME CARBAMATE INSECTICIDES FOR REPELLING A PEST BIRD (*LONCHURA STRIATA*) TO REDUCE EAR DAMAGE OF FOX-TAIL MILLET

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A field trial was conducted at RARS, Hathazari, Chittagong with three carbamate insecticides, isoprocarb, carbosulfan and carbaryl replicated 3 times during both the 1988-89 and 1990-91 cropping seasons to test their efficacy in repelling the pest bird, *Lonchura striata,* and to reduce ear damage of fox-tail millet. Two applications of these insecticides on ripening millet at 15 and 7 days before harvest reduced bird damage and increased yield significantly as compared to control. Among the insecticides, isoprocarb was the best, followed by carbosulfan and carbaryl in both seasons.

Key words: Repellent, Damage, Millet.

Introduction

Fox-tail millet (*Setaria italica* Beauv.) is a minor grain crop in Bangladesh with high yield potential. The ripening ears of the crop may be severely damaged by several species of birds, namely the munias (*Lonchura* spp.), baya weaver (*Placus philippinus*) and the house sparrow (*Passer domesticus*) [1]. Of these, the white-backed munia (*Lonchura striata*) appears to be the principal bird pest of fox-tail millet in Bangladesh. As this crop is becoming increasingly popular in this country, it is necessary to protect it from bird damage at the ripening stage.

Because of the ineffectiveness of most of the bird-scaring devices available [2] and the high cost of labour for driving birds away from crop fields, chemical repellents have been used to protect field crops from damage by pest birds in many countries [3-6]. Methiocarb, a carbamate insecticide, is the most effective chemical used to repell pest birds from crop fields at seeding, sprouting and maturing stages in several countries of the world [3, 4, 7, 8]. However, methiocarb is not yet registered in Bangladesh as a pesticide for controlling insect pests and repelling pest birds. This study was undertaken to test the efficacies of three available carbamate insecticides, namely isoprocarb, carbosulfan and carbaryl as repellents against white-backed munias at the maturing stage of fox-tail millet.

Materials and Methods

The experiment was conducted at the Regional Agricultural Research Station (RARS), Hathazari, Chittagong in a randomized complete block design with four treatments replicated three times during both the 1988-89 and 1990-91 cropping seasons. The seeds of fox-tail millet variety 'Titas' were sown on 17th Dec 1988 for 1988-89 experiment and on Jan 3rd, 1991 for 1990-91 experimental plots measuring 10.0 m x 10. 0 m with spacing of 25.0 cm and 10.0 cm between rows and plants, respectively. The distance between plots in each replicate was 10 m. The distance between replicates was maintained at 10 m. For optimum plant growth, two irrigations by flooding were made at 6 and 8 weeks after sowing. The treatments were isoprocarb (2-isopropyl-phenyl-N-methylcarbamate; Mipcin 75 WP) @ 1.0 g/l of water, carbosulfan [2,3-dihydro-2-dimethyl-7-benzofuranyl {(dibutylamino)thio} methylcarbamate; Marshall 20 EC] @ 1.0 m/l of water, carbaryl (1-naphthyl methylcarbamate; Seven 85 SP) @ 1.0 g/l of water, and a control (water spray only). The dose of each chemical formulation was 10.0 gm/ml per plot at each application. Insecticide was applied by a high pressure knap-sack sprayer using hollow cone type of nozzle in the calm afternoon having no natural precipitation.

The number of birds (*L. striata*) visiting each plot were counted during peak feeding periods 1 hr each at dawn and dusk daily for one week before the first application of repellents. The visiting birds which stayed for at least 5 min or more in a particular plot were counted for that plot.

The first application of repellents was made on the upper canopy of the ripening millet at 15 days before harvest. The number of birds visiting each plot were counted as above each day for one week following the first application. Increasing bird visits 7 days after the first application initiated the time of the second application. The second application was made 7 days before harvest. The number of bird visits were counted daily after the second spray till the day before harvest.

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The ears were harvested on 6th April, 1989 from five randomly selected quadrates (1.0 m^2) per plot for determining grain yield (t/ha) following threshing and cleaning. The methodology adopted in 1988-89 was repeated for the experiment in 1990-91 except for the date of harvest (10 April, 1991) . Analysis of variance (ANOVA) and least significant difference (LSD) were done to see the differences found on each observation date, as well as a pooled ANOVA for the complete study period for each of the two years. Similarly AVOVA of damaged ear, harvested ear, mean damage per harvested ear for each of the treatments and grain yield (t/ha) were also performed and their means separated by LSD.

Results and Discussion

The number of birds counted in all the plots within 17-23 days before harvest (i.e. before first spray) were not significantly different from each other in both the 1988-89 and 1990-91 cropping seasons (Table 1) which encouraged the necessity for spraying chemicals.

The 1988-89 and 1990-91 experiments showed that the number of birds visiting plots were reduced significantly for all three carbamate treatments compared to controls (Table 2 and 3). The greatest repellency in both the trials occurred in plots treated with isoprocarb, followed by carbosulfan, carbaryl and the control plots.

Of the repellents applied 15 and 7 days before harvest in 1988-89, isoprocarb was the best repellent (range= 0-16 visits per day) followed by carbosulfan (range = 7-41 visits per day) and carbaryl (range = 11-59 visits per day). The number of bird visits per day in all treated plots was significantly lower than in the control plots (range=23-140 visits per day) (Table 2 and 3).

TABLE 1. THE NUMBER OF BIRDS COUNTED IN DIFFERENT PLOTS WITHIN 17-23 DAYS BEFORE HARVEST IN BOTH THE 1988-89 AND 1990-91 CROPPING SEASONS.

	Days before harvest, 1988-89						
Treatment	23	22	21	20	19	18	17
Isoprocarb	0.33	1.00	2.33	2.33	5.33	5.33	13.67
Carbosulfan	0.33	1.33	2.00	2.67	4.67	8.00	15.00
Carbaryl	0.00	0.33	3.00	2.67	5.33	7.00	14.67
Untreated (Control)	0.67	1.33	2.00	3.00	5.67	7.00	18.33
LSD (P≤-0.05)	NS	NS	NS	NS	NS	NS	NS
1990-91							
Isoprocarb	1.33	3.33	4.00	7.00	16.33	23.67	20.00
Carbosulfan	1.67	2.67	2.00	4.33	12.67	18.33	28.33
Carbaryl	3.67	4.00	5.33	8.33	16.33	23.33	60.33
Untreated (Control)	0.33	2.00	3.00	5.00	10.00	14.00	28.33
LSD (P≤0.05)	NS	NS	NS	NS	NS	NS	15.20

TABLE 2. THE NUMBER OF BIRDS COUNTED IN DIFFERENT TREATMENT PLOTS WITHIN 9-15 DAYS BEFORE HARVEST IN 1988-89, 1990-91 AND POOLED OF TWO YEARS.

	Days before harvest, 1988-89						
Treatment	15	14	13	12	11	10	09
Isoprocarb	0.00	2.00	6.33	8.00	11.33	11.00	16.00
Carbosulfan	7.00	8.00	15.00	24.67	35.00	39.00	40.00
Carbaryl	10.67	16.00	27.33	37.33	54.33	53.33	55.00
Untreated	23.33	33.67	51.33	61.67	71.00	87.33	92.67
LSD (P≤0.05)	1.43	3.74	9.79	13.84	14.56	22.99	15.48
1990-91							
Isoprocarb	1.33	2.33	8.67	17.00	9.00	10.00	15.33
Carbosulfan	15.00	27.00	62.33	47.00	43.00	46.00	47.00
Carbaryl	29.00	38.33	88.00	79.67	62.00	58.33	74.67
Untreated	48.00	64.67	120.67	99.67	102.67	101.67	123.00
LSD (P≤0.05)	11.85	13.12	29.42	20.62	24.94	13.91	18.27
POOLED							
Isoprocarb	1.33	4.33	15.00	25.00	20.33	21.00	31.33
Carboulfan	22.00	35.00	77.33	71.67	78.00	85.00	87.00
Carbaryl	39.67	54.33	115.33	117.00	116.33	111.67	129.67
Untreated	71.33	98.33	172.00	161.33	173.67	189.00	215.67
LSD (P≤0.05)	3.42	4.89	12.14	10.79	12.23	11.82	10.68

TABLE 3. THE NUMBER OF BIRDS COUNTED IN DIFFERENT TREATMENT PLOTS WITHIN 1-7 DAYS BEFORE HARVEST IN 1988-89, 1990-91 AND POOLED OF TWO YEARS.

	Days before harvest, 1988-89						
Treatment	07	06	05	04	03	02	01
Isoprocarb	1.00	4.00	7.33	11.00	4.33	6.33	7.67
Carbosulfan	7.33	12.00	16.00	20.00	19.00	25.00	40.67
Carbaryl	14.33	21.33	26.00	32.00	37.00	43.67	59.33
Untreated	88.67	96.67	112.67	121.00	124.00	123.33	140.33
LSD (P≤0.05)	4.46	8.04	8.65	8.35	12.83	16.24	22.37
1990-91							
Isoprocarb	1.00	4.00	6.67	9.33	10.00	12.33	15.67
Carbosulfan	8.00	20.67	23.67	30.33	33.00	54.00	69.00
Carbaryl	18.33	36.33	46.00	49.00	47.67	83.33	91.33
Untreated	51.00	72.67	81.67	94.00	98.67	113.67	114.67
LSD (P≤0.05)	4.62	10.85	5.81	15.04	13.31	24.28	26.06
POOLED							
Isoprocarb	2.00	8.00	14.00	20.33	14.33	18.67	23.33
Carbosulfan	15.33	33.00	39.67	50.33	52.00	79.00	109.67
Carbaryl	32.67	57.67	72.00	81.00	84.67	127.00	150.67
Untreated	139.67	169.33	202.00	215.00	222.67	237.00	255.00
LSD (P≤0.05)	3.17	5.45	5.01	7.37	8.25	10.42	15.26

The 1990-91 experiment had comparable results to the 1988-89 experiment. Isoprocarb was again the best repellent (range = 1-17) followed by carbosulfan (range = 8-69), carbaryl (range = 18-91) and the untreated plots (range = 48-123). And, the pooled analyses of two cropping seasons also

TABLE 4. EFFECT OF THREE CARBAMATE REPELLENTS AGAINST MUNIAS ON EAR DAMAGE AND YIELD OF FOX-TAIL MILLET AT RARS, HATHAZARI, CHITTAGONG IN 1988-89 AND 1990-91.

Treatment	Harvested ear/30m²	Damaged ear/30m²	Mean damage/ harvested ear	Grain yield(t/ha)
Isoprocarb	2933.67	64.33	0.02	5.29
Carbosulfan	2605.00	390.00	0.15	4.21
Carbaryl	2209.67	773.33	0.35	3.53
Untreated	1713.00	1259.00	0.73	2.26
LSD(P≤0.05)	587.06	137.64	0.06	0.10
CV (%)	13.25	11.82	10.25	1.29
1990-91				
Isoprocarb	2852.00	135.00	0.05	4.69
Carbosulfan	2113.67	875.33	0.41	3.51
Carbaryl	1877.67	1097.33	0.58	2.80
Untreated	1425.33	1558.67	1.09	1.61
LSD(P≤0.05)	385.28	186.80	0.12	0.09
CV (%)	9.95	10.88	11.08	1.52

$$\text{* Mean damage per harvested ear} = \frac{\text{Damaged ear per } 30m^2}{\text{Harvested ear per } 30m^2}$$

show the same trend of bird attack (Table 2 and 3).

In 1988-89, mean damage per harvested ear was significantly lower (P≤ 0.05) in isoprocarb plots than in carbosulfan, carbaryl and untreated plots (Table 4). Though the mean damage per harvested ear in the later two carbamate treated plots were significantly higher than in isoprocarb treated plots, they were significantly lower than in the untreated plots.

Mean damage per harvested ear in 1990-91 was significantly higher in all carbamate treated plots than observed in 1988-89. This was also observed between experiments in the control plots. The lowest damage per harvested ear was in isoprocarb treated plots, followed by carbosulfan, carbaryl and the control plots (Table 4).

Similarly, in a laboratory study, it was found that carbosulfan was 3.6 times more effective than carbaryl in repelling the munias in a feeding study [1]. The present study indicated that isoprocarb was more repellent to munias than other carbamates, hence the acute oral LD_{50} values for this compound needs to be evaluated as determined [1] for carbosulfan (1.77 mg/kg) and carbaryl (2.97 mg/kg).

In both experiments, all plots treated with carbamate insecticides gave significantly higher (P≤0.05) grain yield per ha as compared to the control (Table 4). Among the carbamates, isoprocarb gave the highest grain yield followed by carbosulfan and carbaryl, with yield differences among treatments being highly significant (p≤0.05) (Table 4).

Since methiocarb has a half life of 6-9 days in the field crop [9, 10] and because methiocarb has a lower mammalian oral LD_{50} than the carbamates tested in this study, the carbamates appear promising for use on ripening millet. Residue studies, however, are required to determine the most appropriate 'pre-harvest' interval for applying these pesticides to ripening millet.

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