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IMPACT OF INSECTICIDES APPLIED IN THE NURSERY ON THE ARTHROPOD FAUNA OF RICE IN THE MAIN FIELD

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ABSTRACT

Application of cartap in the nursery at 1.0 kg a.i./ha did not have a negative impact on the populations of *Lycosa pseudoannulata, Tetragnatha javana, Cyrtorrhinus lividipennis* and *Paederus fuscipes* in the main field. However, cartap at higher dose and chlorpyriphos as seedling treatment were found safer to *L. pseudoannulata*. Application of cartap and carbofuran in the nursery five days before pulling out was found to be very effective in containing the populations of both *Nephotettix virescens* Distant and *Nilaparvata lugens* Stal. in the main field upto 40 days after transplanting.

KEY WORDS : Predators, spiders, nursery treatment, insecticides, safety to predators

Predators of rice pests are among the least studied arthropods. Even though insecticide application is the most commonly used method for controlling the hppers in the rice fields, its usage has inevitably been followed by pest resistance and outbreaks of secondary pests. In the present study, the effect of certain insecticides used in the nursery and their ultimate impact on the pest and predator population in the main field was studied.

MATERIALS AND METHODS

To study the effect of insecticides applied in the nursery on hopper incidence in the main field and their impact on the natural enemy population, this trial was laid out in a randomised block design with four replications. The nursery was divided into plots of 10 to 15 sq.m before sowing and bunded on all sides. There were eight treatments : carbofuran (Furadan 3G) at 1.5kg a.i./ha ; carbofuran (Furadan 3G) at 1.0kg a.i./ha ; quinalphos (Ekalux 3G) at 1.5kg a.i/ha ; quinalphos (Ekalux 3G) at 1.0kg a.i./ha ; cartap (Padan 4G) at 1.5kg a.i./ha ; cartap (Padan 4G) at 1.0kg a.i./ha ; chlorpyriphos (Durmet 20 EC) at 0.02% and untreated control.

The granular formulations were broadcast evenly five days before pulling out the seedlings. A depth of two to five cm of water was maintained in the nursery before broadcasting the granules and the water was impounded until the seedlings were pulled out. For seedling root dip, roots untreated seedlings were dipped for 12 h in 0.02 per cent solution of chlorpyriphos before transplanting in the main field. Observations on hoppers and natural enemies were made on 10, 20, 30 and 40 days after treatment (DAT) on 10 random hills per plot.

RESULTS AND DISCUSSION

Effect on predators

Among the insecticides tested, application of cartap (both at 1.0 and 1.5 kg a.i./ha) and quinalphos (5G) at 1.0 kg a.i./ha in the nursery did not affect the populations of *Lycosa pseudoannulata* Boes. et Str. in the main field (Table 1). However, quinalphos (1.5 kg a.i./ha) and carbofuran (at both the doses) were more toxic than the other treatments. There was a positive trend in the predator population which reached a maximum of 7.72 per 20 hills at 40 DAT. The interaction between treatments and periods was also significant.

All the insecticides had a significant negative effect on the population of *Tetragnatha javana* Thorell compared to control. Cartap at 1.0 kg a.i./ha was less toxic compared to the other insecticides. Quinalphos at 1.5 kg a.i./ha supported the least population of the spider (1.75) and this was statistically on par with carbofuran at both the doses as well as with the higher dose of cartap (2.42). The maximum population of *T. javana* was noticed at 40 DAT (Table 2).

Carbofuran was toxic to *L. pseudoannulata* and *Microvelia atrolineata* Bergroth (Microveliidae:Hemiptera). Broadcasting

Table 1. Effect of nursery treatment with insecticides on the population of *L. pseudoannulata*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran	1.50 B	4.25 A	3.75 A	3.17
(1.5kg a.i./ha)	(1.32) b	(2.15) a	(2.01) de	(1.83) c
Carbofuran	2.25 B	4.00 AB	5.50 A	3.92
(1.0kg a.i./ha)	(1.65) b	(2.11) a	(2.39) cde	(2.05) bc
Quinalphos	1.50 B	4.25 A	3.25 AB	3.00
(1.5kg a.i./ha)	(1.39) b	(2.11) a	(1.92) e	(1.81) c
Quinalphos	5.25 B	6.00 B	9.75 A	7.00
(1.0kg a.i./ha)	(2.38) a	(2.52) a	(3.19) ab	(2.69) a
Cartap	5.50 A	6.75 A	8.50 A	6.92
(1.5kg a.i./ha)	(2.41) a	(2.67) a	(2.98) bc	(2.69) a
Cartap	5.00 B	6.25 AB	10.25 A	7.17
(1.0kg a.i./ha)	(2.31) a	(2.59) a	(3.18) ab	(2.69) a
Chlorpyriphos	1.50 B	7.00 A	6.75 A	5.08
(0.02%)	(1.35) b	(2.71) a	(2.66) bcd	(2.24) b
Untreated control	5.00 B	5.75 B	14.00 A	8.25
	(2.33) a	(2.47) a	(3.80) a	(2.87) a
Mean	3.44	5.53	7.72	
	(1.89) C	(2.42) B	(2.77) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test)

* Mean of three replications

Figures in parentheses are ($\sqrt{x + 0.5}$) transformed values

carbofuran was found toxic to *L. pseudoannulata* and *Tetragnatha* sp. and *Oxyopes* sp. (Khusakul *et al.*, 1979).

The seedling treatment with chlorpyriphos had the least effect on *M. atrolineata* (19.75/10 hills). Muralidhara Rao *et al.* (1983) also reported similar

Table 2. Effect of nursery treatment with insecticides on the population of *T. javana*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran	1.00 B	1.50 B	4.00 A	2.17
(1.5kg a.i./ha)	(1.13) b	(1.32) c	(2.06) cd	(1.50) cd
Carbofuran	1.75 A	2.25 A	2.25 A	2.08
(1.0kg a.i./ha)	(1.49) ab	(1.63) bc	(1.61) d	(1.58) cd
Quinalphos	1.00 B	1.00 B	3.25 A	1.75
(1.5kg a.i./ha)	(1.18) b	(1.13) c	(1.92) cd	(1.41) d
Quinalphos	1.50 B	2.00 B	5.50 A	3.00
(1.0kg a.i./ha)	(1.40) ab	(1.58) bc	(2.39) bc	(1.79) cd
Cartap	1.50 B	2.25 AB	3.50 A	2.42
(1.5kg a.i./ha)	(1.32) ab	(1.64) bc	(1.95) cd	(1.64) cd
Cartap	2.75 B	4.00 B	6.75 A	4.50
(1.0kg a.i./ha)	(1.80) a	(2.09) b	(2.64) b	(2.18) b
Chlorpyriphos	1.50 B	1.75 B	4.50 A	2.58
(0.02%)	(1.40) ab	(1.49) c	(2.21) bc	(1.70) cd
Untreated control	3.00 B	8.75 A	10.00 A	7.25
	(1.84) a	(3.03) a	(3.22) a	(2.70) a
Mean	1.75	2.94	4.97	
	(1.45) C	(1.74) B	(2.25) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test).

* Mean of three replications

Figures in parentheses are ($\sqrt{x + 0.5}$) transformed values

Table 3. Effect of nursery treatment with insecticides on the population of *M. atrolineata*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran	6.00 B	12.25 A	7.75 AB	8.67
(1.5kg a.i./ha)	(2.49) d	(3.55) bc	(2.86) e	(2.97) d
Carbofuran	6.50 B	13.50 A	11.00 A	10.33
(1.0kg a.i./ha)	(2.63) cd	(3.72) abc	(3.37) de	(3.24) cd
Quinalphos	9.00 B	9.50 A	17.00 A	11.83
(1.5kg a.i./ha)	(3.05) bcd	(3.14) c	(4.18) bc	(3.46) c
Quinalphos	14.50 A	16.00 A	15.50 A	15.33
(1.0kg a.i./ha)	(3.84) ab	(4.02) ab	(3.95) cd	(3.94) b
Cartap	10.75 B	16.00 AB	22.00 A	16.25
(1.5kg a.i./ha)	(3.34) abc	(4.03) ab	(4.70) abc	(4.02) ab
Cartap	15.00 A	15.25 A	20.25 A	16.83
(1.0kg a.i./ha)	(3.93) a	(3.93) abc	(4.54) bc	(4.13) ab
Chlorpyriphos	15.75 B	20.00 AB	23.50 A	19.75
(0.02%)	(4.01) a	(4.51) a	(4.89) ab	(4.47) a
Untreated control	11.75 C	19.25 B	29.00 A	20.00
	(3.46) ab	(4.40) a	(5.41) a	(4.42) a
Mean	11.16	15.22	18.25	
	(3.35) C	(3.91) B	(4.24) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test).

* Mean of three replications

Figures in parentheses are ($\sqrt{x+0.5}$) transformed values

results. Application of cartap (1.0 and 1.5 kg a.i./ha) recorded significantly lower populations of 16.83 and 16.25 respectively. Carbofuran at both doses supported the least population of this predator. The build up of the predator was gradual reaching a maximum population of 18.25 on 40

Table 4. Effect of nursery treatment with insecticides on the population of *C. lividipennis*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran	1.75 B	2.25 AB	4.00 A	2.67
(1.5kg a.i./ha)	(1.48) c	(1.63) d	(2.10) de	(1.73) c
Carbofuran	3.25 AB	2.25 B	4.50 A	3.33
(1.0kg a.i./ha)	(1.92) abc	(1.59) d	(2.20) cde	(1.90) bc
Quinalphos	2.50 A	3.25 A	4.25 A	3.33
(1.5kg a.i./ha)	(1.70) bc	(1.91) d	(2.13) de	(1.91) bc
Quinalphos	3.25 B	5.75 A	3.75 AB	4.25
(1.0kg a.i./ha)	(1.85) abc	(2.47) bc	(2.05) e	(2.13) b
Cartap	3.50 B	6.50 A	7.50 A	5.83
(1.5kg a.i./ha)	(1.98) abc	(2.62) ab	(2.82) ab	(2.47) a
Cartap	3.75 B	9.00 A	6.50 A	6.42
(1.0kg a.i./ha)	(2.06) ab	(3.07) a	(2.63) bcd	(2.59) a
Chlorpyriphos	2.50 B	3.75 B	6.75 A	4.33
(0.02%)	(1.73) bc	(2.05) cd	(2.69) abc	(2.16) b
Untreated control	5.25 B	6.25 B	9.75 A	7.08
	(2.38) a	(2.57) ab	(3.20) a	(2.72) a
Mean	3.22	4.88	5.88	
	(1.89) C	(2.24) B	(2.48) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test)

* Mean of three replications

Figures in parentheses are ($\sqrt{x+0.5}$) transformed values

Table 5. Effect of nursery treatment with insecticides on the population of *P. fuscipes*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran (1.5kg a.i./ha)	1.50 B (1.39) bc	1.00 B (1.13) c	3.25 A (1.92) b	1.92 (1.43) d
Carbofuran (1.0kg a.i./ha)	1.75 B (1.48) bc	2.25 AB (1.63) ab	3.25 A (1.93) b	2.42 (1.68) cd
Quinalphos (1.5kg a.i./ha)	2.25 B (1.65) abc	1.50 B (1.28) bc	4.00 A (2.11) b	2.58 (1.68) cd
Quinalphos (1.0kg a.i./ha)	2.75 A (1.76) ab	3.00 A (1.85) a	3.25 A (1.92) b	3.00 (1.84) bc
Cartap (1.5kg a.i./ha)	1.75 B (1.49) bc	3.50 A (1.98) a	4.25 A (2.15) ab	3.17 (1.87) abc
Cartap (1.0kg a.i./ha)	2.75 B (1.77) ab	3.00 B (1.86) a	4.75 A (2.28) ab	3.50 (1.97) ab
Chlorpyriphos (0.02%)	1.25 B (1.31) c	2.25 B (1.64) ab	4.75 A (2.28) ab	2.75 (1.74) bc
Untreated control	3.25 B (1.92) a	2.75 B (1.79) a	6.00 A (2.55) a	4.00 (2.09) a
Mean	2.16 (1.60) B	2.41 (1.64) B	4.19 (2.14) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test).
* Mean of three replications
Figures in parentheses are ($\sqrt{x+0.5}$) transformed values

DAT. The interaction between treatments and periods was also statistically significant (Table 3).

Cartap had the least effect on the population of *Cyrtorhinus lividipennis* Reuter (Miridae Hemiptera) in the main field (Table ...

Table 6. Effect of nursery treatment with insecticides on the population of *N. lugens*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran (1.5kg a.i./ha)	2.00 (1.56)	1.50 (1.32)	2.00 (1.56)	1.83 (1.48) ab
Carbofuran (1.0kg a.i./ha)	0.75 (1.00)	2.25 (1.65)	1.50 (1.40)	1.50 (1.35) abc
Quinalphos (1.5kg a.i./ha)	0.75 (1.06)	2.00 (1.56)	2.00 (1.54)	1.58 (1.39) ab
Quinalphos (1.0kg a.i./ha)	1.50 (1.39)	2.50 (1.71)	2.50 (1.70)	2.17 (1.60) a
Cartap (1.5kg a.i./ha)	0.50 (0.97)	0.50 (0.93)	1.50 (1.32)	0.83 (1.07) c
Cartap (1.0kg a.i./ha)	0.75 (1.00)	1.25 (1.26)	1.25 (1.26)	1.08 (1.17) bc
Chlorpyriphos (0.02%)	1.00 (1.18)	1.25 (1.31)	1.00 (1.13)	1.08 (1.21) bc
Untreated control	0.75 (1.06)	2.50 (1.70)	3.25 (1.93)	2.17 (1.56) a
Mean	1.00 (1.15) B	1.72 (1.43) A	1.88 (1.48) A	

In a column and in a row means followed by the same letter are not significantly different (P=0.05; Dúcan's (1951) multiple range test)
* Mean of three replications
Figures in parentheses are ($\sqrt{x+0.5}$) transformed values
Interaction between treatments and periods was not statistically significant

Table 7. Effect of nursery treatment with insecticides on the population of *N. virescens*

Treatment	Population (No./10 hills)* Period (Days after transplanting) 20	30	40	Mean
Carbofuran	2.00 B	5.00 A	3.75 A	3.58
(1.5kg a.i./ha)	(1.56) d	(2.34) ab	(2.05) c	(1.98) cd
Carbofuran	2.75 B	7.00 A	6.00 A	5.25
(1.0kg a.i./ha)	(1.77) bcd	(2.71) a	(2.54) b	(2.34) b
Quinalphos	1.75 B	3.50 A	2.75 AB	2.67
(1.5kg a.i./ha)	(1.48) d	(1.94) bc	(1.79) c	(1.74) d
Quinalphos	3.75 B	3.00 B	8.00 A	4.92
(1.0kg a.i./ha)	(2.05) bc	(1.86) c	(2.90) ab	(2.27) b
Cartap	2.25 A	2.75 A	3.50 A	2.83
(1.5kg a.i./ha)	(1.65) cd	(1.79) c	(1.98) c	(1.81) d
Cartap	1.50 B	3.00 A	3.75 A	2.75
(1.0kg a.i./ha)	(1.40) d	(1.85) c	(2.04) c	(1.77) d
Chlorpyriphos	4.00 B	2.75 B	7.00 A	4.58
(0.02%)	(2.11) b	(1.76) c	(2.71) b	(2.19) bc
Untreated control	6.50 B	6.75 B	10.00 A	7.75
	(2.63) a	(2.67) a	(3.23) a	(2.84) a
Mean	3.06	4.22	5.59	
	(1.83) C	(2.12) B	(2.41) A	

In a column, means followed by the same letter (lower case) and in a row means followed by the same letter (upper case) are not significantly different (P=0.05; Duncan's (1951) multiple range test)

* Mean of three replications

Figures in parentheses are ($\sqrt{x + 0.5}$) transformed values

Chlorpyriphos was the next best supporting a mean population of 4.33. Cartap at both the doses was statistically on par with control (Table 5). The maximum population of *Paderus fuscipes* F. was reached on 40 DAT (4.19). It is also evident that upto 30 DAT, the population of the predator did not increase indicating that the insecticides suppressed the population increase of the stapyhlinid. Pfrimmer (1964) reported that regular application of insecticides almost totally suppress the beneficial arthropod population.

Effect on prey

For *N. lugens* cartap at 1.5 kg a.i./ha was the most effective insecticide tested (Table 6). It was statistically on par with the same insecticide at the lower dose as well as with seedling treatment of chlorpyriphos and nursery application of carbofuran at 1.0 kg a.i./ha. Quinalphos at 1.5 kg a.i./ha was the best in suppressing the population of *Nephotettix virescens* Horvath (2.67) compared to control (Table 7). However, this treatment was statistically on par with cartap at both the doses as well as with the higher dose of carbofuran.

The trials indicated the safety of cartap as nursery treatment to the predatory populations in the main field while they confirmed the toxicity of carbofuran in suppressing them. Insecticide selectivity (Ripper, 1956) could be attained by physiological or ecological mode. In the present situation, it could be seen that the selectivity of cartap could most probably be due to the interaction of both the modes. Mortality of predators usually occurs not only by direct contact but also be ingesting prey that had taken up the insecticides (Kiritani and Kawahara, 1973). In the present study, the problem of direct toxicity has been avoided while whatever mortality occurred was probably due to food chain poisoning. Since the predator has to search out its prey, it is expected to pick up greater amounts of toxicant and thus suffer greater mortality than the more sedentary pests occupying the same habitat. This problem could be avoided by using a safer insecticide like cartap and that too by nursery treatment.

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RICE RATOONING AS INFLUENCED BY VARIETIES, NITROGEN AND CUTTING HEIGHT

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ABSTRACT

Field experiments were conducted during *Kharif* and *rabi* seasons of 1990-91 at the Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam to study the performance of rice ratooning as influenced by varieties, nitrogen and cutting height. Four varieties *viz.*, ADT 36, ASD 16, CO 37 and PMK 1, three nitrogen levels (75,100 and 125 kg/ha) and cutting heights of 20 and 30 cm were tested in a split plot design. In the main crop, ADT 36 recorded maximum grain yield, wherein the ratoon crop, CO 37 registered the highest grain yield (2.56 and 2.61 t/ha in *kharif* and *rabi* respectively) followed by PMK 1. Growth and yield attributes like plant height, productive tillers, grains per panicle, panicle length and days to maturity were influenced by varieties and nitrogen. Per day productivity was the highest (32.5 and 30.0 kg/ha in *kharif* and *rabi* respectively) for rice variety CO 37. Nitrogen applied at 125 kg/ha recorded higher yield attributes and grain yield in ratoon rice. Cutting height had no significant influence on ratoon rice. The cost benefit ratio was maximum for variety CO 37.

KEY WORDS : Rice, ratoon, variety, nitrogen, cutting height, yield, economics

Rice ratooning is practiced in countries like U.S.A., China, Japan and India. But it has not been practiced for large scale commercial farming because of lack of good ratooning varieties and better management techniques. In Tamil Nadu, rice ratooning is normally not practiced except in parts of Chengalpat district. The most ideal condition for ratooning is the single crop lowland areas under canal and tankfed systems. In single crop wetlands, water is unutilised towards the end of season for about one and half to two months. The surplus water can be economically utilised for a ratoon crop after the harvest of single crop instead of leaving it as fallow. Ratoon rice has the advantages of shorter duration, low production cost and higher per day productivity. Hence, the present study was conducted to evaluate the suitability of varieties, N and cutting height for ratoon rice.

MATERIALS AND METHODS

Field experiments were conducted at the Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam during *kharif* and *rabi* seasons of 1990-91 to find out the performance of rice ratooning as influenced by varieties, N and cutting height in a split plot design replicated thrice. Varieties (ADT 36, ASD 16, CO 37 and PMK 1) and cutting height (20 and 30 cm) formed the main plot and N levels (75, 100 and 125 kg/ha) formed the subplot. Soil type was typic haplustalf having low available N, medium in available P and K. The main crop was raised by following recommended agronomic practices with a spacing 15 x 10 cm. The main crop was harvested leaving stubbles at 20 and 30 cm height from the ground level. Three levels of N (75, 100 and 125 kg/ha) were applied in three splits *viz.*, immediately