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INTEGRATION OF VARIETAL RESISTANCE, INSECTICIDES AND THE PREDATORY WOLF SPIDER, *Lycosa pseudoannulata* IN THE SUPPRESSION OF RICE HOPPERS

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ABSTRACT

Studies were conducted at the Tamil Nadu Agricultural University, Coimbatore on the response of the wolf spider *Lycosa pseudoannulata* Boes et Str. to different insecticides on varieties exhibiting varied levels of resistance to the brown planthopper (BPH), *Nilaparvata lugens* (Stal.) and the green leafhopper (GLH) *Nephotettix virescens* (Dist.) Combination of varietal resistance and predator was found to play an important part in the suppression of both the pests. The mortality of BPH ranged from 96 to 97.67 per cent respectively on the resistant IR 62 and the moderately resistant IR 64 when treated with ethofenprox in the presence of the wolf spider. Ethofenprox applied either on the susceptible or resistant variety was very effective in suppressing BPH. Combination of varietal resistance and the wolf spider revealed that even maximum control could be evinced with a moderately resistant variety.

KEY WORDS : *Lycosa pseudoannulata, Nilaparvata lugens, Nephotettix virescens,* Insecticides, Varietal Resistance, Integration.

Spiders living in cultivated cereal fields show relatively high population densities. Together with the carnivorous beetles they form the most abundant ground dwelling predators of insects in cereal fields (Nyffeler and Benz, 1987). Regular application of insecticides is found to almost totally suppress the beneficial arthropod population (Pfrimmer, 1964) Toxicity of insecticides to spiders has been studied by several authors. Ressing *et al.* (1982) have monitored the effects of 10 insecticides on hoppers and predators on rice fields. They have reported the the majority of insecticides were not harmful to the predators like spiders and mirid bug. The present study was conducted with a view to find out how the wolf spider *Lycosa pseudoannulata* Boes. et.Str. would respond to insecticides on rice varieties exhibiting various levels of resistance and supress the populations of the brown planthopper (BPH), *Nilaparvata lugens* (Stal) and the green leafhopper (GLH) *Nephotettix virescens* (Dist.)

MATERIALS AND METHODS

Interaction between *L.pseudoannulata*, insecticides and varieties with different levels of resistance in the suppression of *N.lugens* population

Investigation were undertaken with three factors in a 3 factorial randomised complete block design to study the interaction between *L.pseudoannulata*, insecticides and varieties with different levels of resistance in the suppression of BPH population. The first factor consisted of the predator *L.pseudoannulata* at two levels (with predator and without predator); the second factor was insecticidal application consisting of five insecticides *viz.,*

Acephate (0.50 kg a.i./ha), BPMC (0.50 kg a.i./ha, Ethofenprox (0.05 kg a.i./ha), Monocrotophos (0.50 kg a.i./ha) and Untreated control.

The third factor consisted of three varieties (IR 62, IR 64 and IR20) with different levels of resistance. There were totally 30 treatments replicated three times. Forty-five day old potted rice plants of the different varieties were cleaned and sprayed with the insecticides at the recommended concentrations and allowed to dry in the shade. They were then covered with mylar cages and into each cage 20: fourth instar BPH nymphs and one female *L.pseudoannulata* were released depending on the treatment. Mortality of the spider and prey was checked daily upto 10 days after treatment (DAT). At each observation, fresh spiders and prey were substituted to maintain their population at the original level.

Interaction between *L.pseudoannulata* and varieties with different levels of resistance over different stages of crop growth on the population of rice hoppers.

BPH

To study the interaction between the wolf spider*L.pseudoannulata* and varieties with different levels of resistance in the suppression of BPH population over different periods of crop growth, an experiment was conducted on one sq.m. micro-plots at the Paddy Breeding Station, Coimbatore. This trial was a modification of the one suggested by Myint *et al.* (1986). The micro-plots were planted with rice seedlings at 15 x 20 cm spacing. Then the plots were carefully examined and all predators were removed. Each plot was infested with five pairs of one day old BPH per hill 30 days after transplanting along with five adult females of *L.pseudoannulata*. The plots were then enveloped with nylon mosquito netting over iron frames. A factorial randomised complete block design was followed with three replications. The varieties consisted of IR 62 and IR 72 (resistant), IR 64 (moderately resistant) and IR 20 (susceptible). Control consisted of plots without the predator. Observations were started a week after release and counts on the nymphs and adults per cage were taken at weekly intervals taking care not to disturb the insects. As the wolf spider is cannibalistic, daily observations on the plots with the spider was taken and whenever there was mortality, the dead spiders were replaced with live ones.

GLH

To comprehend the interaction between the wolf spider *L.pseudoannulata* and varieties with different levels of resistance in the suppression of GLH population over different periods of crop growth, a trial was laid out in the same line as in the previous experiment except for the fact that infestation by the leafhopper was done 20 DAT.

Table 1. Mortality of BPH due to te combined effect of predation by spider, resistance and insecticides

Predator	Insecticide	Mortality (%)* Variety: Resistant (IR 62)	Morderately Resistant (IR 64)	Susceptible (IR 20)
Present	Acephate	89.17 (70.77) efg	90.33 (71.87) def	91.50 (73.16) de
	BPMC	86.83 (68.75) f-i	93.00 (74.82) cd	92.00 (73.58) cde
	Ethofenprox	96.00 (78.57) ab	97.67 (81.27) a	94.83 (76.83) bc
	Monocrotophos	89.17 (70.80) fg	88.50 (70.16) e-h	90.67 (72.20) ef
	Control	77.17 (61.45) l	84.33 (66.67) hij	77.50 (61.69) l
Absent	Acephate	85.17 (67.36) g-j	86.83 (68.70) f-i	82.83 (65.53) ijk
	BPMC	84.67 (66.93) hij	88.33 (70.04) e-h	87.33 (69.13) fgh
	Ethofenprox	94.67 (76.64) bc	92.00 (73.58) cde	91.33 (72.92) de
	Monocrotophos	81.33 (64.38) jkl	78.50 (62.37) kl	84.67 (66.92) hij
	Control	36.83 (37.33) m	5.00 (12.34) n	4.66 (12.40) n

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

* Mean of three replications

Figures in parentheses are (angular) transformed values

RESULTS AND DISCUSSION

Interaction between *L.pseudoannulata* varieties and insecticides in the suppression of BPH

The data on the effect of three factors *viz.*, varietypredator and insecticides on the population of BPH are presented in table 1. The maximum mortality of the hopper (97.67%) occurred in the moderately resistant IR 64. The mortality of BPH ranged from 96 to 97.67 per cent respectively on the resistant IR 62 and the moderately resistant IR 64 when treated with ethofenprox in the presence of the wolf spider. These two treatments were superior to other treatments in suppressing the hopper population. Ethofenprox applied on the susceptible variety also recorded a mortality of 94.83 per cent and was statistically on par with the same insecticide applied on the resistant variety in the presence of the predator. This treatment was also statistically on par with the same insecticide applied to the resistant variety when the predator was absent. Rajamanikam (1988) accounted the effectiveness of this chemical against *N.lugens* and its safety to *L.pseudoannulata*. Krishnaiah and Kalode (1993) also reported the efficacy of ethofenprox in checking the build-up of *N.lugens* and its safety to the mirid bug and spiders under field conditions. Comparing the control plots, the minimum mortality of the hopper occurred on the moderately resistant and susceptible varieties without *L.pseudoannulata*. The importance of the predator in suppressing the hopper population is evident in the sense that when the resistant variety recorded a hopper mortality of 36.83 per cent, without the wolf spider, 77.17 and 77.50 per cent mortality was achieved on the resistant and susceptible varieties respectively with *L.pseudoannulata*.

Interaction between varieties, predator and period in the suppression of BPH

The maximum population of the hopper occurred at 49 days after infestation (DAI) (Table 2). On the susceptible variety (IR 20), in the absence of spiders, the population per cage reached a peak of 584 which was significantly more than in all the other treatments. But in the presence of *L.pseudoannulata* on the same variety, maximum population was 207.33 only indicating the impact of the wolf spider on the hopper population. The minimal population of BPH was recorded on 70 DAI on the moderately resistant IR 64 (1.67) which

Table 2: Population of BPH as affected by varietal resistance and predation by *L. pseudoannulata* at different stages of crop growth

Treatment	Variety	Population per cage* Period (DAI)** 7	14	21	28	35	42	49	56	63	70
Without Predator	IR 62	7.67 (2.81)s-y	38.00 (6.17)f-n	37.67 (6.08)f-n	37.00 (6.04)f-o	131.67 (11.17)cd	33.33 (5.74)f-p	22.67 (4.78)h-v	17.00 (4.13)j-x	16.33 (4.04)k-x	20.33 (4.56)i-w
	IR 64	14.00 (3.78)m-y	33.67 (5.72)f-p	39.33 (6.22)f-n	38.00 (6.06)f-o	23.00 (4.60)i-v	154.33 (12.28)bc	49.67 (6.98)f-i	47.00 (6.69)f-j	53.33 (7.29)fgh	42.00 (6.43)f-l
	IR 72	6.33 (2.57)u-y	11.33 (3.39)p-y	16.00 (3.93)l-y	24.00 (4.83)h-v	104.33 (9.87)de	28.67 (5.27)f-s	26.67 (5.09)h-u	26.67 (5.10)g-u	13.67 (3.67)n-y	11.33 (3.44)p-y
	IR 20	60.67 (7.73)ef	118.00 (10.81)cd	140.33 (11.82)cd	67.33 (7.66)efg	113.66 (10.67)cd	584.00 (23.91)a	132.67 (11.51)cd	158.33 (12.48)bc	11.33 (3.41)p-y	29.67 (5.47)f-r
With Predator	IR 62	3.67 (2.03)wxy	5.33 (2.41)v-y	7.33 (2.76)s-y	8.00 (2.86)s-y	12.33 (3.51)o-y	40.67 (6.29)f-m	23.33 (4.86)h-v	8.67 (2.99)q-y	11.67 (3.46)p-y	3.00 (1.84)xy
	IR 64	3.00 (1.86)xy	3.00 (1.79)xy	9.00 (3.04)q-y	6.00 (2.51)v-y	15.67 (4.01)l-x	96.33 (9.83)de	17.00 (3.97)l-y	15.33 (3.93)l-y	6.67 (2.68)t-y	1.67 (1.44)y
	IR 72	2.67 (1.72)xy	5.33 (2.39)v-y	2.67 (1.77)xy	3.00 (1.86)xy	8.00 (2.91)r-y	30.33 (5.55)f-q	7.33 (2.74)s-y	5.67 (2.48)v-y	5.67 (2.47)v-y	2.33 (1.68)xy
	IR 20	20.33 (4.56)i-w	24.00 (4.93)h-v	43.67 (6.58)f-k	40.67 (6.39)f-l	207.33 (14.35)5b	40.67 (6.18)f-n	38.67 (6.11)f-n	26.33 (5.14)g-t	34.33 (5.88)f-p	23.33 (4.88)h-v

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

* Mean of three replications

** Da s after infestation

Table 3. Population of GLH as affected by varietal resistance and predation by *L. pseudoannulata* at different stages of crop growth

Treatment	Variety	Population per cage*									
		Period (DAI)**									
		7	14	21	28	35	42	49	56	63	70
Without Predator	IR 62	125.33 (11.07)l-;	104.33 (10.14)l-~	182.33 (13.24)f-r	155.00 (12.42)i-x	180.33 (13.26)f-r	219.67 (14.63)c-l	205.00 (14.24)d-m	361.00 (18.94)bc	199.67 (14,12)d-n	144.67 (12.05)i-y
	IR 72	77.67 (8.74)r-~	102.00 (9.44)p-~	167.33 (12.67)g-v	141.67 (11.79)i-z	136.00 (11.63)j-z	128.67 (11.20)l-;	212.00 (13.99)e-o	119.00 (10.73)l-;	107.33 (10.35)l-}	119.00 (10.89)l-;
	IR 64	102.00 (10.08)m-~	134.67 (11.45)k-{	169.67 (12.89)g-u	177.00 (13.16)g-t	213.33 (14.51)c-m	847.67 (29.08)a	344.33 (18.35)b-e	299.67 (17.16)b-g	296.00 (17.18)b-g	294.00 (17.11)b-h
	IR 20	127.67 (11.09)l-;	119.67 (10.78)l-;	267.67 (16.16)c-j	259.67 (16.09)c-j	361.00 (18.89)bc	890.33 (29.65)a	346.33 (18.57)bcd	321.00 (17.76)b-f	220.33 (14.66)c-l	193.33 (13.91)e-p
With Predator	IR 62	87.33 (9.36)q-~	57.33 (7.50)z-~	76.33 (8.69)s-~	31.67 (5.60)~	66.33 (7.89)x-~	57.00 (7.52)y-~	92.33 (9.60)o-~	266.33 (16.28)c-i	103.67 (10.08)m-~	47.33 (6.82);}~
	IR 72	36.00 (6.01)}~	90.33 (9.26)q-~	67.00 (8.10)w-~	56.00 (7.42)z-~	121.00 (10.90)l-;	90.33 (9.30)q-~	115.33 (10.72)l-;	253.00 (15.86)c-k	75.67 (8.68)t-~	61.00 (7.63)y-~
	IR 64	90.67 (9.55)o-~	75.00 (8.49)u-~	117.67 (10.76)l-;	49.33 (7.00){-~	153.67 (12.39)i-x	162.33 (12.61)h-w	296.33 (16.97)b-h	68.00 (8.13)v-~	116.33 (10.76)l-;	48.00 (6.82);}~
	IR 20	116.33 (10.20)l-}	145.67 (11.90)i-z	90.67 (9.51)o-~	87.00 (9.33)q-~	180.00 (13.29)f-q	454.00 (21.24)b	180.33 (13.23)f-s	162.33 (12.61)h-w	104.67 (10.22)l-}	68.33 (8.18)v-~

In a column, means followed by the same letter/symbol are not significantly different (P=0.05); Duncan's (1951) multiple range test (symbols { ; }~ are used in that order after z)

*Mean of three replications

** Days after infestation

was statistically on par with the population on resistant IR 62 and IR 72 with *L.pseudoannulata* and with IR 72 without *L.pseudoannulata*. However, these treatments were significantly superior to the susceptible variety IR 20 (with and without the predator) as well as IR 62 and IR 64 without the predator. Association of varietal resistance and predator was found to play an important part in the suppression of the population of N.lugens (Kartohardjono and Heinrichs, 1984; Salim and Heinrichs, 1986). The higher the level of resistance, the higher the planthopper mortality and this might be due to the combined effects of varietal resistance and predation which would produce an additive effect.

Interaction between predator and varietal resistance in the suppression of the green leafhopper GLH

The population of GLH reached a peak of 890.33/cage 42 DAI on the susceptible IR 20 and was statistically on par with the moderately resistant IR 64 (847.67) at the same period in the absence of the wolf spider (Table 3). However, these treatments were significantly inferior to all the varicities tested when *L.pseudoannulata* was present. The minimum population of the hopper was noticed on IR 62 (with *L.pseudoannulata)* on 28 DAI which was statistically on par with the population on all the varieties with the predator but significantly superior to the varieties without predator. It was observed earlier that *L.pseudoannulata* when confied with *N.lugens / Sogatella furcifera / N.virescens* on cultivars with different degrees of resistance devoured more prey on resistant cultivars than on susceptible (Kalode *et al.*, 1990).

The present tests indicated the high degree of hopper contol when varieties with high levels of resistance were confined with the spider. Reductions in an insect population through varietal resistance maximised natural enemy activity and provided a more favourable ratio of pests to natural enemies (Dhams, 1972). Kaneda (1986) reported that Japonica breeding lines seemingly with degraded antibiosis to *N.lugens* under caged and predator free conditions were found to be fully efficacious in suppressing *N.lugens* population below ETL under conditions of normal plant growth and active natural enemies. Boonprapitak (1987) has portrayed that variety and age of the plant at the time of infestation significantly influenced the the predatory potency of each predator. He has shown that a combination of resistant variety and a predator gave a better control of *S.furcifera* than either of the methods alone. The effectiveness of the wolf spider under field conditions, however, might be less than in these tests when the prey was confined to cages and the choice of food for the predator was limited. The wolf spider is well known for its cannibalistic tendencies as well as its capacity to feed on other beneficial arthropods, thus severely limiting its value as a predator.

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EFFECT OF PLANT DENSITY AND NUTRIENT LEVELS ON NEW COTTON VARIETIES

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ABSTRACT

Experiments were conducted at the Tamil Nadu Agricultural University, Coimbatore during the winter seasons of 1991-92, 1992- 93 and 1993-94 to find out the optimum spacing and fertilizer level for the new varieties of cotton. The results revealed that the varieties LRK 516, MCU 11, TCH 1002 and TCH 1028 recorded more seed cotton yield with closer spacings of 75 x 20 cm and 60 x 15 cm with a fertilizer level of 80:40:40 kg NPK ha^{-1}.

KEY WORDS : Cotton varieties, Spacing, Fertilizer Level, Seed Cotton Yield.

Population and geometry varies with plant type, its architecture, soil fertility and soil moisture (Bonde, 1992). To obtain maximum yield of cotton, it is essential to find out the optimum combination (Nagwekar *et al.*, 1987). Therefore an experiment was conducted to study the effect of spacing (plant population) and fertilizer levels on some new varieties of cotton.