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Effects of Insect Control on the Economic Returns in Riec

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Through field trials conducted in three consecutive seasons, Kharif, Rabi 1979-80 and Kharif 1980, in gains yields, due to insect pest control at different crop phases, were estimated. Three different insecticidal schedules consisting of carbofuran followed by quinalphos or monocrotophos and their combinations were evaluated for their efficacy, importance and economical value. The gain when protected at reproductive phase (P_2) ranged from 20-209% over control while when protected at maturity (P_3) the gain observed was 25 to 97%. Protecting the crop only at tillering phase (P_1) was found uneconomical. The monetary loss varied from Rs. 284 to 782 per hectare. Additional gains have been realised, when P_2 was either preceded by P_1 or followed by P_3. In Rabi season, P_3 assumed as much importance as P_2 but either of the two only was economically feasible.

Earlier estimations reveal that on an average 25-30% grain is lost due to insect pests of rice (Cramer 1967, Israel *et al*., 1968, Pathak and Dyck 1973. Barr *et al*., 1975, Khosla, 1977 and Van Halteren 1977). Resorting to chemical control remains alternative until reliable multi pest resistant varieties are developed in rice. Screening insecticides for more than a decade sorted out carbofuran as the effective granular formulation against internal feeders, while monocrotophos and quinalphos as sprays for external feeders of rice (Anonymous 1976). The damage potential varies with pest incidence, time and stage of the crop, (Dina 1976). Yellow stem borer causes damage throughout, while the others like rice thrips, whorl maggot, gall midge, leaf folder, leaf hoppers etc., occur at different stages of rice crop. Based on the stage of the crop and the relative pest incidence, timing of insecticidal schedules were fixed and gain in yields due to insect pest control were estimated.

MATERIAL AND METHODS

Two field trials in Kharif 1979 and 1980 and one in Rabi 1979-80 were conducted in replicated randomized blocks. The subject varieties were Jaya in Kharif and Tella Hamsa in rabi. The rice crop in the main field was differentiated into three stages viz., 1. tillering phase, 2. reproductive phase and 3. maturing phase, for timing the insecticide schedules to prevent damage due to insects associated with a particular stage.

The efficacy of the insecticidal schedules in pest control for gain in yields was evaluated as single treatments in reference to the particular crop phase and additional benefit derived due to interaction of schedules. So the treatments and the combinations studied

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were (1) P_0—no protection, (ii) P_1—protection at tillering phase, (iii) P_2—protection at reproductive phase, (iv) P_3—protection at maturing phase, (v) p_1+P_2, (vi) P_1+P_3, (vii) P_2-P_3 and (viii) $P_1+P_2+P_3$. During Kharif 1980, there were only five of the above treatments exculsive of (v), (vi) and (vii).

The data on pest incidence, collected at fortnight intervals from 25 days after transplanting (DAT) and grain yields, were subjected to statistical analysis. The effects of the treatment schedules and the interactions were worked out. The net gains for the different treatments were computed.

RESULTS AND DISCUSSION

A) i) *Pest incidence*:- Rice thrips, *Baliothrips biformis*, whorl maggot, *Hydrellia sp.*, gall midge, *Orseolia oryzae* and yellow stem borer, *Scirpophaga incertulas* occured at tillering phase in Kharif 1979 and 1980. Leaf folder (*Cnaphalocrocis medinalis*) damage was extensive in reproductive phase during both the seasons. Inspite of the presence and damage throughout the crop period, the borer broods advanced and ceased earlier in Kharif, 1980 than in 1979. It resulted in more damage at tillering and reproductive phases than at maturing stage of 1980 crop, while the trend was reverse in 1979. The phenological manifestation of midge incidence appeared not to cause potential damage during both the Kharif seasons (Tables 1 and 3). Stem borer was the only pest of significance during rabi season causing damage at late reproductive and maturing phase (Table 2).

ii) *Effect of insecticidal treatments:* Protecting crop only at tillering phase (p_1) was of no economical significance. It seems to have some value in stem borer control, had the pest appeared very early in the season as in Kharif 1980. The resurgence of gall midge within a month in the plots of P_1 treatment, shows its effect as adverse rather than beneficial, if the crop is left unprotected later (table—1). Protection of the crop at reproductive phase (P_2) was found essential and of paramount significance for the control of leaf folder and stem borer. The importance of P_3 was more felt on Kabi crop.

iii) *Interaction effects*:- The beneficial effect of P_1 was long-lasting, provided P_2 was involved in follow up action. Eventhough P_1 was followed by P_3; the contribution for pest control was insignificant in the absence of protection at reproductive phase (P_2).

B) *Gain in yields*:- Protection at reproductive (P_2) and maturing (P_3) phases contributed substantially for additional yields.

i) *Treatment effect*:- The gain in yields due to P_1, was 25, 5, 31; due to P_2 was 137, 24, 210 and due to P_3 was 73, 25, 97 percent over untreated control in the seasons of 1979, 1979-80 and 1980, respectively (Table 1 to 3). P_2 resulted in improved yields over P_3 during Kharif 1980, when the borer occurred in advance in the season.

ii) *Treatment combination effect*:- The control of various pests cotinuously throughout the Kharif crop period, resulted in increased yields. However,

during Rabi, the effect of combination was economically unproductive (Table 2). In a complete schedule (P_1+ P_2+P_3) the earlier treatments contibuted for higher yields due to saving of productive tillers'. On Kharif crop, P_1 effect was pronounced in increased yields, supplementary to the gain with p_2. Similarly P_3 preceded by P_2 has shown extra gain (table 4).

C) *Economics of pest control schedules*:- The net returns of protection schedules were dependent on the occurrence and intensity of pest incidence during crop period. In Kharif 1979, the full protection schedule resulted in loss due to slight but marked late appearance of economically important pest species viz., the borer and midge (Table 1). In Rabi, 1980, even two applications were not economical. A single schedule either at reproductive or maturing phase was found useful (Table 2). The full schedule (P_1+P_2+P_3) seemed to yield maximum economical returns in case the pest incidence was significant throughout the growth period as in Kharif 1980. However, even under such conditions a single schedule of P_2 appeared to be sound and economical (Table 3).

An overall review of data of the three seasons indicate that a single schedule of insecticide application during reproductive phase of the crop was most crucial as well as enonomical for optimum gains.

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Table 1 Insect pest incidence at different stages and grain yields in Kharif 1979

Treatment	25 DAT	40 DAT		55 DAT		70 DAT		Preharvest	Yield kg/ha	% gain	Net profit (Rs.)
	T	DH	SS	DH	LF	SS	DH	WE		over control	
P_0	6.3b	20.5b	3.1a	13.0b	19.8b	3.8b	20.6b	46.2c	812c	—	—
P_1	0.6a	18.9b	8.2b	17.5b	20.8b	4.0b	19.6b	46.6c	605c	—25.5	—782
P_2	5.2b	8.3a	1.5a	1.5a	0.1a	0.5a	6.2a	27.4b	1925b	137.0	194
P_3	5.1b	19.3b	4.7b	13.5b	15.4b	2.1a	14.3b	23.9b	1402b	72.6	—204
P_1+P_2	0.9a	12.6a	3.3a	1.5a	0.1a	1.9a	6.7a	28.6b	2719a	234.8	286
P_1+P_3	0.5a	18.0b	5.3b	17.2b	18.9b	3.5b	11.8b	27.8b	1305b	60.7	—820
P_2+P_3	0.6b	9.7a	1.4a	0.8a	0.1a	1.1a	3.6a	16.2a	2881a	254.8	300
$P_1+P_2+P_3$	0.6a	11.7a	1.8a	1.8a	0.1a	1.9a	3.3a	12.5a	3152a	288.2	—52

Means within column followed by a comman letter are not significantly different at 5% level

P_0=No protection; P_1=Protection at Tillering phase; P_2=P otection at reporoductive phase; P_3=Protection at maturing phase,

SS=Silver shoots; DH=Dead hearts; WE=White ears; WM=Whorl maggot; T=Rice Thrips; LF=Leaf folder.

Paddy @ Rs. 95/- per quintal; Carbofuran @ Rs. 14/- Per kg. Monocrotophos @ Rs. 165/- per litre; Quinalphos @ Rs. 85/- per litre.

Table 2 Insect pest incidence at different stages and grain yields-Rabi 1979-80.

Treatment	40 DAT DH	55 DAT DH	70 DAT DH	Preharvest WE	Yield in Kgs/ha	% gain over control	Net profit (Rs.)
P_0	4.2b	10.3b	10.4b	11.6b	3959c	—	—
P_1	1.6b	6.9b	8.2b	15.1b	4142c	4.6	—408
P_2	1.4b	1.0a	1.3a	12 6b	4902b	23.8	144
P_3	2.4b	6.6b	6.8b	1.7a	4964b	25.4	249
P_1+P_2	0.6a	0.7a	1 8a	10.4b	5197a	31.3	—159
P_1+P_3	1.7b	8.1b	9.4b	1.7a	4794b	21.1	—495
P_2+P_3	1.7b	0.4a	1.0a	1.2a	5404a	36.5	—85
$P_1+P_2+P_3$	0.9a	0.1a	1.7a	0.8a	5508a	39.1	—568

Table 3 Insect pest incidence at different stages and grain yields-Kharif 1980.

Treatment	25 DAT		40 DAT		55 DAT		70 DAT	p.e-harvest		Yield in kg/ha.	% grain over control	Net profit (Rs.)
	DH	WM	DH	SS	DH	LF	SS	DH	WE			
P_0	19.9b	16.3b	21.1c	6.1b	10.5b	16.3b	2.9b	19.1c	20.6d	959d	—	—
P_1	3.4a	5.5a	8.0b	22.7c	9.6b	21.5b	8.5c	16.4b	35.4e	1257d	31.1	—284
P_2	18.4b	17.0b	9.4b	0.9a	0.5a	0.1a	0.4a	4.1a	16.0c	2968b	209.5	950
P_3	19.4d	15.2b	21.9c	6.7b	12.2b	18.9b	4.2b	14.7b	7.3b	1892c	97.3	87
$P_1+P_2+P_3$	1.8a	5.6a	3.1a	0.4a	0.5a	0.1a	0.1a	2.4a	1.9a	4869a	407.7	1282

Table 4 Treatmental effect Vs. Yield gain.

Treatment	Kharif 1979 Yield gain (Kgs/ha)		Rabi 1979-80 Yield gain (Kgs/ha)		Kharif 1980 Yield gain (Kgs/ha)	
	Direct effect	Combination effect	Direct effect	Combinarion effect	Direct effect	Combination effect
P_1 (Protection at Tillering phase)	0	271	183	104	298	968
P_2 (Protection at productive phase)	1113	1846	943	714	2009	2679
P_3 (Protection at maturing phase)	590	433	1006	312	933	1603