The Pharma Innovation Journal 2022; 11(10): 457-461

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(10): 457-461

www.thepharmajournal.com
Received: 19-08-2022
Accepted: 30-09-2022

Priti Priya
Ph.D., Scholar, Department of Entomology, BAU, Kanke, Ranchi, Jharkhand, India

Rabindra Prasad
Associate Professor, Department of Entomology, BAU, Kanke, Ranchi, Jharkhand, India

Sountharya R
Ph.D., Scholar, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
Priti Priya
Ph.D., Scholar, Department of Entomology, BAU, Kanke, Ranchi, Jharkhand, India

Management of leaf folder through use of host plant resistance and insecticidal application

Priti Priya, Rabindra Prasad and Sountharya R

Abstract
The present investigation was conducted in *Kharif* 2018 in the Rice research farm of Birsa Agricultural University, Ranchi, Jharkhand to study the management of leaf folder through use of HPR (host plant resistance) and insecticidal application. The experimental findings revealed that use of host plant resistance coupled with judicious application of newer molecule of insecticide i.e. flubendiamide 480 SC @ 50 ml/ha sprayed at 30, 50 and 80 DAT could be found highly effective in substantial reduction in the incidence of leaf folder which in turn realized appreciable enhancement in additional yield over the untreated control in all the five varieties of rice amounting to 20.0, 16.10, 14.00, 11.22 and 10.10 q/ha in case of Lalat, IR-64 (drt-1), Sahbhagi Dhan, BVS- 1, TN-1, respectively.

Keywords: Management, plant, resistance, insecticidal application

Introduction
Rice is one of the major sources of calories for half of the world's population and in Jharkhand it is considered as the dominant food crop. This crop has been the most traditional land use and the main economic variable that has historically shaped social relations (Narayanan 2006). Rice is a high energy food and play vital role in national food security. It contains high carbohydrates 77.84% and low fat about 2.0 to 2.5%. It is also a good source of thiamine, riboflavin and niacin including eight essential amino acids (Prakash *et al*., 2007) [4].

The productivity of rice crop is threatened by a number of insect pests attacking the crop from nursery to harvest, causing enormous yield loss. The rice crop is a perfect target for a variety of insect pests starting from the time of sowing till the crop is harvested. Beside yellow stem borer, rice leaf folder (*Cnaphalocrocis medinalis* Gn.) is another new emerging important insect pest in rice. Murugesan and Chelliah (1983) [2] reported that a 10% increase in flag leaf damage by the leaf folder reduces grain yield by 0.13g per tiller and the number of filled grains by 4.5%. The symptoms of leaf folder damage are characterized by the presence of a large number of leaf folds. The larvae, prior to feeding, fold the leaves longitudinally and fasten the leaf margins with stitches of silk thread. The larvae feed by scraping the chlorophyll content from inside of the folded leaves. The vigor and photosynthetic ability of an infested rice plant is greatly reduced and yield loss is high when the flag leaf is damaged. (Fraenkel *et al*., 1981) [1].

Use of host plant resistance coupled with need based and judicious application of recommended insecticides could be one of essential tools (components) of IPM for sustainable production of rice with no harm or minimum harm to the rice agro-ecologies. Therefore, HPR and need based use of the insecticides were integrated in the form of an experiment and conducted in the field to meet the objective of the present studies.

Materials and Methods
The present study was conducted in *Kharif* 2018 in the Rice research farm of Birsa Agricultural University, Ranchi, Jharkhand. Five promising and popular rice varieties IR-64 (drt-1), Sahbhagi Dhan, Lalat, BVS-1 and TN-1 as susceptible check were grown in each of the protected as well as in unprotected conditions. As such, there were 10 treatment combinations with three replication, laid-out in randomized block design with plot size of 4mx 5 m.

Protected condition were provided with three foliar spray of flubendiamide 480 SC @ 50 ml/ha, 1 at 30 DAT, 2nd at 50 DAT and 3% at 80 DAT. Unprotected condition was provided to all the 5 rice varieties by allowing them for natural infestation with the leaf folder. Observations in terms of leaf damage (LD) were recoded before spray and at 5, 10 & 14 days after application (DAA) of each foliar sprays on 10 randomly selected plants (hills).

Percentage of leaf damage (LDLF %) was calculated by the following formula as suggested by SES of IRRI, Philippines:

$$\text{\% leaf damage (LDLF \%)} = \frac{\text{Total no. of damaged leaves (LDLF)/ 10 hills}}{\text{Total number of leaves (damaged + healthy)/10 hills}} \times 100$$

Results and Discussion

Table 1: Effect of HPR and use of insecticide on the incidence of leaf folder in different genotypes of rice, record after **1st** spray

Tr. No.	Rice varieties	Protection measures	Percentage of leaf damage caused by leaf folder (LDLF %) at DAA of insecticidal application after			
			1st spray at 30 DAT			
			5 DAA	10DAA	14 DAA	Overall Mean
T1	IR-64 (drt-1)	*Pn-Need based protection	5.40 (13.34)	6.20 (14.40)	7.80 (16.05)	6.46 (14.67)
T2	IR-64 (drt-1)	**Po-No protection	14.65 (22.49)	16.38 (23.86)	18.35(25.35)	16.46 (23.92)
T3	Sahbhagi Dhan	Pn-Need based protection	4.30 (11.80)	5.30 (13.07)	5.90 (14.00)	5.16 (13.20)
T4	Sahbhagi Dhan	Po-No protection	10.60 (18.96)	11.40 (19.71)	12.40 (20.54)	11.46 (19.75)
T5	Lalat	Pn-Need based protection	5.70 (13.68)	7.30 (15.55)	7.90 (16.29)	6.96 (15.19)
T6	Lalat	Po-No protection	16.80 (24.18)	18.30 (25.30)	20.50 (26.90)	18.53 (25.48)
T7	BVS-1	Pn-Need based protection	4.60 (12.13)	5.80 (13.63)	6.30 ((14.47)	5.56 (13.34)
T8	BVS-1	Po-No protection	10.33 (18.73)	14.40 (22.28)	18.30 (25.92)	14.34 (22.19)
T9	TN-1 (SC)	Pn-Need based protection	4.80 (12.44)	6.40 (14.48)	7.30 (15.59)	6.16 (14.32)
T10	TN-1 (SC)	Po-No protection	17.80 (24.92)	18.50 (25.45)	20.60 (26.95)	18.96 (25.75)
S.Em (±)		Factor(A)-Variety	(0.41)	(0.49)	(0.46)	(0.45)
		Factor(B)-insecticide)	(0.64)	(0.78)	(0.73)	(0.72)
		Factor(A X B)	(0.91)	(1.10)	(1.04)	(1.01)
CD, P=(0.05)		Factor(A)	(1.22)	(1.47)	(1.39)	(1.36)
		Factor(B)	(1.94)	(2.33)	(2.20)	(2.15)
		Factor(A X B)	(2.74)	(3.30)	(3.12)	(3.04)
CV (%)			(9.19)	(10.17)	(8.96)	(9.37)

Factor (A) = variety, Factor (B) = Insecticide, HPR- host plant resistance *Pn- Need based protection were provided in the form of foliar sprays with flubendiamide 480 SC @ 50ml/ha starting 1 at 30 DAT, 2 nd at 50 DAT and 3% at 80 DAT (days after transplanting) **Po- No protection were provided to all the 5 test varieties for allowing them for natural infestation with the leaf folder

Table 2: Effect of HPR and use insecticide on the incidence of leaf folder in different genotypes of rice, record after 2nd spray

Tr. No.	Rice varieties	Protection measures	Percentage of leaf damage caused by leaf folder (LDLF %) at DAA of insecticidal application after			
			2nd spray at 50 DAT			
			5 DAA	10 DAA	14 DAA	Overall Mean
T1	IR-64 (drt-1)	*Pn-Need based protection	8.30 (16.64)	8.30 (16.68)	4.70 (12.43)	7.10 (15.34)
T2	IR-64 (drt-1)	**Po-No protection	20.65 (27.01)	21.50 (27.59)	9.50 (17.94)	17.21 (24.48)
T3	Sahbhagi Dhan	Pn-Need based protection	6.50 (14.62)	6.90 (15.19)	2.40 (8.59)	5.26 (13.20)
T4	Sahbhagi Dhan	Po-No protection	15.30 (23.00)	16.46 (23.91)	8.30 (16.73)	13.35 (21.41)
T5	Lalat	Pn-Need based protection	8.20 (16.40)	8.60 (17.01)	5.60 (13.60)	7.46 (15.70)
T6	Lalat	Po-No protection	22.60 (28.36)	24.30 (29.51)	14.50 (22.37)	19.43 (26.13)
T7	BVS-1	Pn-Need based protection	7.80 (16.10)	7.40 (15.62)	3.48 (10.30)	6.22 (14.39)
T8	BVS-1	Po-No protection	21.40 (27.53)	22.40 (28.19)	11.40 (19.71)	18.40 (25.38)
T9	TN-1 (SC)	Pn-Need based protection	7.80 (16.19)	8.20 (16.53)	3.60 (10.64)	6.53 (14.61)
T10	TN-1 (SC)	Po-No protection	23.70 (29.09)	26.70 (31.09)	20.17 (26.66)	23.52 (28.99)
S.Em (±)		Factor(A)-variety	(0.42)	(0.48)	(0.45)	(0.44)
		Factor(B)-insecticide	(0.66)	(0.76)	(0.72)	(0.69)
		Factor(A X B)	(0.94)	(1.07)	(1.02)	(0.98)
CD, P=(0.05)		Factor(A)	(1.26)	(1.44)	(1.36)	(1.32)
		Factor(B)	(2.00)	(2.27)	(2.15)	(2.08)
		Factor(A X B)	(2.83)	(3.21)	(3.05)	(2.95)
CV (%)			(7.61)	(8.40)	(11.09)	(8.56)

Factor (A) = Variety, Factor (B) = Insecticide, HPR- host plant resistance

Table 3: Effect of HPR and use insecticide on the incidence of leaf folder in different genotypes of rice, record after 3% spray

Tr. No.	Rice varieties	Protection measures	Percentage of leaf damage caused by leaf folder (LDLF %) at DAA of insecticidal application after			
			3% spray at 80 DAT			
			5 DAA	10 DAA	14 DAA	Overall Mean
T1	IR-64 (drt-1)	*Pn-Need based protection	5.80 (13.78)	6.70 (14.90)	7.80 (16.13)	6.63 (14.84)
T2	IR-64 (drt-1)	**Po-No protection	18.70 (25.61)	20.60 (26.97)	21.70 (27.74)	20.63 (26.97)
T3	Sahbhagi Dhan	Pn-Need based protection	3.20 (10.19)	4.30 (11.88)	5.30 (13.24)	4.26 (11.82)
T4	Sahbhagi Dhan	Po-No protection	13.70 (21.70)	15.60 (23.24)	17.18 (24.44)	15.49 (23.08)
T5	Lalat	Pn-Need based protection	4.60 (12.25)	5.22 (13.06)	6.30 (14.49)	5.37 (13.29)
T6	Lalat	Po-No protection	20.30 (26.76)	22.40 (27.92)	23.60 (29.00)	22.23 (28.10)
T7	BVS-1	Pn-Need based protection	4.80 (12.48)	5.70(13.60)	6.70 (14.96)	5.73 (13.57)
T8	BVS-1	Po-No protection	19.30 (26.04)	20.60 (26.97)	22.60 (28.36)	20.53 (26.92)
T9	TN-1 (SC)	Pn-Need based protection	5.70 (13.66)	6.30 (14.48)	7.30 (15.62)	6.56 (14.76)
T10	TN-1 (SC)	Po-No protection	20.80 (27.11)	22.30 (28.16)	24.60 (29.71)	22.43 (28.23)
S.Em (±)		Factor(A)-variety	(0.35)	(0.38)	(0.36)	(0.36)
		Factor(B)-insecticide	(0.55)	(0.60)	(0.57)	(0.57)
		Factor(A X B)	(0.78)	(0.85)	(0.81)	(0.81)
CD, P=(0.05)		Factor(A)	(1.05)	(1.14)	(1.09)	(1.09)
		Factor(B)	(1.66)	(1.81)	(1.73)	(1.73)
		Factor(A X B)	(2.35)	(2.56)	(2.45)	(2.44)
CV (%)			(7.16)	(7.34)	(6.70)	(7.00)

Factor (A) = Variety, Factor (B) = Insecticide, HPR- host plant resistance

Table 4: Effect of certain rice varieties and protection measures on grain's yield of rice Tr

No.	Rice varieties	Protection measures	Yield (q/ha)
T1	IR-64 (drt-1)	*Pn-Need based protection	44.60
T2	IR-64 (drt-1)	**Po-No protection	28.50
T3	Sahbhagi Dhan	Pn-Need based protection	41.50
T4	Sahbhagi Dhan	Po-No protection	27.50
T5	Lalat	Pn-Need based protection	46.50
T6	Lalat	Po-No protection	26.50
T7	BVS-1	Pn-Need based protection	40.40
T8	BVS-1	Po-No protection	29.18
T9	TN-1 (SC)	Pn-Need based protection	34.60
T10	TN-1 (SC)	Po-No protection	24.50
	S.Em (±)	Factor (A)-Variety	(0.68)
	CD, P= (0.05)	Factor (B)-insecticide)	(1.08) Factor (A X B) (1.54)
		Factor (A)	(2.06)
		Factor (B)	(3.26)
		Factor (A X B)	(4.61)
	CV (%)		(7.75)

Factor (A) = variety, Factor (B) = Insecticide, HPR- host plant resistance

Table 5: Economics and benefit cost ratio of different varieties of rice under protected conditions

Tr. No.	Rice varieties	Protection measures	Yield of rice grain (q/ha)	Additional gain in yield over unprotected condition (q/ha)	Price of additional yield over unprotected condition (Rs./q)	Cost of pest control (Rs./ha)	Net profit (Rs/ha)	Benefit cost ratio (B:C ratio)
T1	IR-64 (drt-1)	*Pn	44.60	16.10	19320	4300	15040	3.4:1
T2	IR-64 (drt-1)	**Po	28.50	-				
T3	Sahbhagi Dhan	Pn	41.50	14.00	16800	4300	12500	2.9:1
T4	Sahbhagi Dhan	Po	27.50	-				
T5	Lalat	Pn	46.50	20.00	24000	4300	19700	4.5:1
T6	Lalat	Po	26.50	-				
T7	BVS-1	Pn	40.40	11.22	28050	4300	23750	5.5:1
T8	BVS-1	Po	29.18	-				
T9	TN-1 (SC)	Pn	34.60	10.10	12120	4300	7820	1.8:1
T10	TN-1 (SC)	Po	24.50	-				

The results are presented in (Table-1). The observations on incidence of leaves damaged % (LDLF %) caused by leaf folder were record at 5 DAA (days after application), 10 DAA and 14 DAA of 1st spray made with flubendiamide @ 50 ml/ha during field experimentation, 2018 in kharif season. Based on the overall results of 1st spray, it was found that the pest incidence in the form of LDLF (%) ranged from 5.16% LDLF (Sahbhagi Dhan) to 6.16% LDLF (TN-1) in the protected condition and 11.46% LDLF (Sahbhagi Dhan) to 18.96% LDLF (TN-1) in unprotected conditions. In general, significantly lower incidence of LDLF% was found in protected condition as compared to unprotected conditions in

case of all the five respective rice varieties. Under protected condition, the lowest incidence of the pest was record in Sahbhagi Dhan (5.16% LDLF) which was at par with BVS-1 (5.46% LDLF), TN-1 (6.16% LDLF), IR 64 (Drt.-1) (6.46% LDLF) and Lalat (6.96% LDLF) whereas, the highest incidence of leaf folder was record in case of Lalat (6.96% LDLF) which was at par with IR 64 (drt-1) (6.46% LDLF), TN-1 (6.16% LDLF), BVS-1 (5.46% LDLF) and Sahbhagi Dhan (5.16% LDLF), respectively, grown under the need based insecticidal protection.

Under unprotected conditions, the lowest incidence of the pest (11.46% LDLF) was record in case of Sahbhagi Dhan which remained at par with that of BVS-1 (14.34% LDLF) whereas, the highest incidence of leaf damaged percent were record (18.96% LDLF) in rice variety TN-1 which was at par with Lalat (18.53% LDLF), IR 64 (drt-1) (16.46% LDLF) under unprotected condition.

Incidence of LDLF (%) after 2nd and 3% spray at 50 DAT and 80 DAT

Almost similar trends in the suppression of leaf folder incidence were observed in case of 2nd and 3% round to that of the 1st spray to that of the first spray under the influence of varietal resistance and need based protection provided with foliar spray applied with flubendiamide 480 SC @ 50 ml/ha. As such, significantly lower incidence of LDLF% was found in protected condition as compared to unprotected conditions in case all the five respective rice varieties in both 2nd (Table-2) and 3% spray (Table-3). Based on the overall results of 2nd spray, made at 50 DAT, under protected condition, the lowest incidence of the pest was record in Sahbhagi Dhan (5.26% LDLF) which was at par with BVS-1 (6.22% LDLF), TN-1 (6.53% LDLF), IR 64 (drt-1) (7.10% LDLF) and Lalat (7.46% LDLF) whereas, the highest incidence of leaf folder was record in case of Lalat (7.46% LDLF) which was at par with IR 64 (drt-1) (7.10% LDLF), TN-1 (6.53% LDLF), BVS-1 (6.22% LDLF) and Sahbhagi Dhan (5.26% LDLF), respectively, grown under the need based insecticidal protection.

Under unprotected conditions, the lowest incidence of the pest (13.35% LDLF) was record in case of Sahbhagi Dhan followed by BVS-1 (18.40% LDLF) Whereas, the highest incidence of leaf damaged percent were record (23.52% LDLF) in rice variety TN-1 which was at par with Lalat (19.43% LDLF), BVS-1 (18.40% LDLF) under unprotected condition.

Based on the overall mean results of 3% spray, made at 80 DAT, under protected condition, the lowest incidence of the pest was record in Sahbhagi Dhan (4.26% LDLF) which was at par with BVS-1 (5.37% LDLF), Lalat (5.73% LDLF), TN-1 (6.56% LDLF) and IR 64 (drt-1) (6.63% LDLF) whereas Under unprotected condition, the lowest incidence of the pest (15.49% LDLF) was record in case of Sahbhagi Dhan which was at par with BVS-1 (20.53% LDLF) in the present investigation.

Effect of HPR (host plant resistant) and insecticidal application on grain's yield of rice

The results are shown in Table-4. It was general observation that the protected crop gave rise to higher grain yield as compared to those of unprotected crop almost in all the respective five rice varieties in terms of yield enhancement due to protection measures provided to the crop.

It is an established fact that yields of grains in different rice varieties was regulated by genetic yield potential of the respective crop varieties as well as effect of other biotic and abiotic factors prevailing in the agro-ecosystem. Higher grains yield to the tune from 26.50 to 46.50 q/ha; 28.50 to 44.60 q/ha; 27.50 to 41.50 q/ha; 29.18 to 40.40 q/ha; 24.50 to 34.60 q/ha were obtained in case of the rice varieties *viz.* Lalat, IR 64(drt-1), Sahbhagi Dhan, BVS-1, TN-1 due to enforcement of varietal intervention coupled with need based insecticidal protection in the experiment.

Benefit cost ratio of different varieties of rice under protected condition

A perusal of results (Table-5) revealed that under protected condition, the highest benefit cost ratio 5.5:1 was record rice variety BVS-1, foliar sprayed with flubendiamide @ 50 ml/ha at 30 DAT, DAT and 80 DAT, giving the net profit of Rs. 23,750/ha. This is followed by Lalat, giving net profit of Rs.19,700/ha with B: C ratio 4.5:1, IR 64 (drt-1) giving rise to net profit of Rs.15040/ha with B: C ratio 3.4:1, Sahbhagi Dhan resulting in net profit of Rs.12,500/ha with B: C ratio 2.9:1 and TN-1 giving net profit of Rs.7,820/ha with B: C ratio 1.8:1 in the present studies.

Interaction effect of varieties and the insecticidal protection on the incidence of rice leaf folder and their impact on yield

The results (Tables-1, 2, 3, 4) revealed that the interactive effects between the test rice varieties and the insecticidal protection and zero protection on the incidence of leaf folder were found to be significant almost throughout the observational period, that in turn, resulted into the significant impact on the interaction of varieties and protection measures on yield of grains in the present studies.

Prasad *et al*. (2010) [5] reported that among the five common rice varieties, in general, the protected crop received lower incidence of the prevailing major insect pest species, *viz*., gall midge, YSB and leaf folder as compared to those of the unprotected crop of the respective varieties. They observed that the pest resistant varieties *viz*., BG380-2, Lalat and Suraksha had significantly lower incidence of all the three major pests as compared to those of the susceptible varieties *viz*. Jaya and Pusa Basmati in general with particular reference to crop grown in the unprotected condition. These findings are almost in the close conformity with that of results of the present field studies.

Conclusions

Use of host plant resistance coupled with judicious application of newer molecule of insecticide i.e. flubendiamide 480 SC @ 50 ml/ha applied at 30, 50 and 80 DAT could be found highly effective in substantial reduction in the incidence of leaf folder which, in turn, realized appreciable enhancement in additional yield over the untreated control in all the five varieties of rice amounting to 20.0, 16.10, 14.00, 11.22 and 10.10 q/ha in case of lalat, IR 64 (drt-1), Sahbhagi Dhan, BVS-1, TN-1, respectively.

In brief, use of HPR (host plant resistance) coupled with application of the appropriate insecticide could be highly effective for minimization in the incidence of leaf folder, and optimization of realization of higher grain's yield of rice with the least harm or no harm to the agro-ecosystem.

Acknowledgements
Authors are thankful to the Hon'ble Vice-Chancellor, the Director of Research and the Dean (Agriculture), Birsa Agricultural University, Kanke, Ranchi for providing facilities, support and moral encouragement for conducting this filed experiment.

References
1. Fraenkel G, Fallil F, Kumara KS. The feeding behavior of the rice leaf folder, *Cnaphalocrocis medinalis*. Entomology Exp Appl. 1981;29(2):147-161.
2. Murugesan S, Chelliah S. Rice yield loss caused by leaf folder damage at tillering stage. International Rice Res. News. 1983;8(1):13-14.
3. Narayanan NC. For and Against Grain Land Use: Politics of Rice in Kerala, India. International Journal of Rural Management. 2006;2(1):1-8.
4. Prakash A, Rao J, Singh ON, Tyagi JP, Singh S, Rath PC. Rice the queen of cereal, AZARA Publication CRRI; c2007. p. 1-40.
5. Prasad R, Prasad D. Use of host plant resistance (HPR) for the management of rice gall midge (*Orseolia oryzae* WM) in Jharkhand. In: Extended abstract of research papers, National symposium on emerging trends in pest management strategies under changing climatic scenario, held on 20-21, Dec. at Orissa University of Agriculture and Technology (OUAT), Bhubneshwar; c2010. p. 28-29.