IMPACT OF ABIOTIC FACTORS ON INCIDENCE INSECT PESTS IN RICE

.

ABSTRACT

The investigation on impact of abiotic factors on incidence of insect pests in rice was carried out during *Kharif* 2021. The highest and lowest Rice Yellow stem borer incidence was recorded at vegetative stage in the form of dead heart at 31st SMW and 40th SMW i.e., 1.10% and 16.48%, respectively, whereas at reproductive stage the highest and lowest incidence was recorded in the form of white ear at 42nd SMW and 41th SMW i.e., 18.12% and 16.75%, respectively. The highest Rice leaf folder incidence was recorded in 36th SMW (16.25%) and lowest in 44th SMW (1.31%). The highest and lowest Rice Gundhi bug mean population was recorded in 39th SMW and 44th SMW *i.e*., 10.30 and 1.31 bugs/hill, respectively. The highest and lowest BPH mean population was recorded in 38th SMW and 41st SMW *i.e*.,10.80 BPH/hill and 1.60 BPH/hill, respectively. The yellow stem borer showed significant positive correlation with relative humidity whereas, non-significant positive correlation with minimum temperature, maximum temperature, rainfall and sunshine. Rice leaf folder population showed significant positive correlation with minimum temperature and relative humidity. Whereas, positive and non-significant correlation with maximum temperature and rainfall. However, negative and non-significant correlation with sunshine. Gundhi bug showed a non-significant positive correlation with Relative humidity, Rainfall and sunshine. However, negative and non-significant correlation with minimum temperature and maximum temperature. BPH population showed significant positive correlation with minimum temperature and relative humidity, however positive and non-significant correlation with maximum temperature and rainfall. Whereas, negative and non-significant correlation with Sunshine.

Keywords: *Rice, Yellow stem borer, Leaf folder, Gundhi bug, Brown plant hopper.*

1. INTRODUCTION

One of the oldest cereal grains, Rice (*Oryza sativa*) is believed to have been grown for at least 5000 years. Rice is the seed of the grass species *O. sativa* (Asian rice) or *O. glaberrima* (African rice). Rice is the world's second-largest cultivated cereal crop. Rice is the staple food crop of over half of the world's population and 90 per cent of Asians. Rice is known as the grain of life and is synonymous with food for Asians (Oudhia *et al*., 1999) [1]. It is grown in 112 nations across six continents and consumed by 2500 million people of the world (Angiras and Attri, 2003) [2]. In India, rice crop occupies an area of about 43.79 million hectares with total production of 116.42 million tones and the productivity of 2659 kg/ha (Anonymous, 2019) [3]. Whereas, in Uttar Pradesh, rice is cultivated more than an area of about 5.74 million hectares with a production of 12.47 million tones and the productivity of 2704 kg/ha (Anonymous, 2019) [3]. Uttar Pradesh ranks second in the country in production of rice after West Bengal (Dwivedi *et al.,* 2011) [4]. Rice is mainly a tropical, sub-tropical and humid plant which is cultivated throughout India. Rice is a good source of nutrition, raw rice contains 6-9 per cent protein, 77-84 per cent carbohydrate and a good source of thiamine (Vitamin B_1), riboflavin (Vitamin B_2) and niacin together with all eight of the essential amino acids (Prakash *et al.,* 2007) [5]. In India, Rice is generally grown by transplanting in puddle soils because the conditions for higher productivity are more promising in transplanted rice, but there is need to increase rice production by about 3 per cent every year over the next decade to feed the increasing population of the country.

Among the major yield limiting factors insect pests are said to be an important one. About 100 species of insects have been reported to attack on rice crop in India. Out of which, 20 have been found to be the serious threat including Rice yellow stem borer, *Scirpophaga incertulas*, Rice leaf folder, *Cnaphalocrosis medinalis*, White backed plant hopper, *Sogatella furcifera*, Brown plant hopper, *Nilaprvata lugens*, Gall midge, *Orseolia oryzae* and Rice Gundhi bug, *Leptocorisa acuta,* which cause 21 to 51 per cent yield loss in different rice agro ecosystem (Dhaliwal and Singh, 1996; Pathak and Khan, 1994) [6,7]. The yield loss estimates due to yellow stem borer, brown plant hopper and gall midge are 25-30, 10-70 and 15-60%, respectively. Leaf folder (10%) and other pests (25%) also cause yield losses (Krishnaiah and Varma, 2013) [8]. Among the insect pests, yellow stem borer (YSB), *S. incertulas* (Walker) is the most destructive pest of rice, causing yield losses to the tune of 10-60 per cent every year (Panda *et al*., 1976; Mahar *et al*., 1985; Pasalu *et al*., 2005) [9,10,11]. Weather conditions play an important role for determining the geographical distribution and periodic abundance of major insect pests in rice (Singh *et al.,* 2012) [12]. The infestation of major insect pests of crops depends on the prevailing weather conditions in an area (Mardi *et al.,* 2009; Seni and Naik, 2018; Jasrotia *et al.,* 2019; Seni, 2020) [13,14,15,16]. Considering above facts, the study was conducted on impact of various abiotic factors on their effect on incidence insect pests in rice.

2. MATERIALS AND METHODS

The present Investigation "Impact of abiotic factors on incidence insect pests in Rice" was conducted at Student's Instructional Farm (SIF), Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The seedlings of rice variety NDR-2065 were raised in nursery by 'Wet bed method'. A seed bed of 6×8 m size was prepared in dry condition. The unit plot size kept 8×8 m with border of 1 m and line to line spacing kept 20 cm and plant to plant spacing kept 15 cm. The number of insect pests present on per 10 randomly selected hills was counted using visual counts for sucking pests and also visual counts for borers at weekly intervals was recorded in this unprotected plot at weekly intervals from the occurrence or initiation of pest infestation and continued up to maturity on standard meteorological week basis. The data of weather factors was obtained simultaneously from the Department of Agrometeorology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The weekly data of pest population were correlated with the prevailing environmental factors such as maximum Temperature, minimum temperature, relative humidity and rainfall in the field. The correlation coefficient (r) analysis was worked out.

Rice stem borer counts were taken on No. of dead hearts/ white ears and total numbers of tillers/ panicles from 10 randomly selected hills. The incidence (dead heart/ white ears) was calculated as fallows

$$\text{Per cent incidence} = \frac{\text{No. of dead hearts / white ears}}{\text{Total number of tillers/penicals}} \times 100$$

Leaf folder damaged leaves and total leaves from 10 randomly selected hills were observed in each plot & the percentage of leaf damage was calculated as fallows

$$\text{Per cent incidence} = \frac{\text{No. of damaged leaves}}{\text{Total numbers of leaves}} \times 100$$

3. RESULTS AND DISCUSSION

Incidence of major insect pests on Rice

The data were recorded on the intensity of major insect pests in Rice and four insect pest emerged as major pest during *Kharif,* 2021 including viz., Rice Yellow stem borer (*Scirpophaga incertulus*), Rice Leaf folder (*Cnapholocrocis medinalis*), Brown plant hopper

(*Nilaparvata lugens*) and Rice Gundhi bug (*Leptocorisa acuta*) at weekly intervals. The data evidenced the active period of pests at various stages of crop growth.

Rice Yellow stem borer (*S. incertulas*)

The incidence of *S. incertulas* was recorded in two stages of crop growth first at vegetative stage *i.e*., dead heart and second at tillering stage *i.e*., white ear. The incidence of dead heart was recorded in 31st SMW (1.10% Dead heart) two weeks after transplanting, the minimum and maximum temperatures prevailed during initial infection were 26.10°C and 33.20°C with 76% relative humidity. The per cent of dead hearts was gradually raised to 11.95% during 38th SMW and reached a maximum during 40th SMW (16.48% dead heart).

The incidence of *S. incertulas* in the form of white ears was observed first during 41th SMW (16.75% white ears), When the minimum and maximum temperatures were 24°C and 34°C, respectively with 79.50% relative humidity. There was a gradual rise in the incidence of per cent white ears and reached maximum at 43th SMW (17.99% white ears) with minimum and maximum temperatures were 18.20°C and 31.10°C, respectively and relative humidity 68.00%. These findings are similar with the finding of Sulagitti *et al.* (2017) [17] who observed the incidence of YSB at 31st SMW and its peak incidence at 41th SMW. These finding also similar to Patel and Singh (2017) [18] reported the incidence of YSB first appeared at 32nd SMW and white ear head reached peak in 45th SMW.

Rice Leaf folder (*C. medinalis*)

The incidence of *C. medinalis* was noted at weekly intervals during the entire crop season of Rice. The leaf damage was first appeared at 31st SMW (2.85% damaged leaves) two weeks after of transplanting, when minimum and maximum temperatures prevailed during initial infection were 26.10°C and 33.20°C with 76% Relative humidity. The Peak of leaf folder was observed at 36th SMW (16.25% damaged leaves) and during this period minimum and maximum temperature ranged from 26.20°C and 33.70°C whereas, the relative humidity 79.40% and rainfall 42.40mm sunshine (3.90 hrs.) though minimum population was noticed at 44th SMW (1.31% damaged leaves). These findings are similar to Sulagitti *et al.* (2017) [17] reported that the first incidence of *C. medinalis* observed at 31st standard meteorological weeks. These finding are also similar to Kakde and Patel (2015) [19] *C. medinalis* population reached at peak level during 39th SMW.

Rice Gundhi bug (*L. acuta*)

The incidence of *L. acuta* on rice was recorded as number of bugs per hill. The appearance of Gundhi bug was observed for first time during 36th standard meteorological weeks *i.e*., seventh week after transplanting (2.40 bugs per hill) with minimum and maximum temperature prevailed during initial infection were 26.10°C and 33.70°C with 79.40% Relative humidity, 42.40 mm, rainfall 3.90 hrs. Sun shine. The Peak population of Gundhi bug was noticed at 39th standard meteorological weeks. During this period minimum and maximum temperature was ranged from 25.10°C and 32.20°C, where relative humidity 84.50%, 63 mm. rainfall and sunshine 7.30 hrs. though minimum population noticed at 44th standard meteorological weeks (1.50 bugs per hill). These finding are agreement with Paikra *et al.* (2019) [20] found the first appearance of insect incidence started at 37th standard meteorological week and attained peak population during 45th standard metrological week. These finding also similar to Sulagitti *et al*. (2017) [17] reported the incidence of *L. acuta* observed first time at 37th SMW and peak incidence of *L. acuta* was recorded at 43th SMW.

Brown plant hopper (*N. lugens*)

The incidence of *N. lugens* was recorded as number of insects per hill. The presence of *N. lugens* was observed first time 31st Standard meteorological week (2.10 hoppers per hill). The minimum and maximum temperature prevailed during initial infection were 26.10°C and 33.20°C with 76% Relative humidity and Rainfall 3mm, sunshine (5.90 hrs.). The Peak population of *N. lugens* was observed during 38th Standard Meteorological Week. During this period minimum and maximum temperature ranged between 25.00°C and 31.20°C, where relative humidity 85.80%, rainfall 41.40 mm and 6.10 hrs. sunshine though minimum populations noticed at 41st standard meteorological weeks (1.60 hoppers per hill). These finding were close association with to Sharma *et al.* (2018) [21] reported the first appearance of BPH Started from 30th standard metrological week and reached to its peak during 40th standard week. These results are also in closed association with Verma *et al.* (2021) [22] incidence started from 33rd standard meteorological week and it attends its peak level during 38th standard meteorological week.

Effect of abiotic factors on the incidence and insect pests of Rice

The correlation between incidence of major insect pests and abiotic factors viz., minimum temperature (°C), maximum temperature (°C), relative humidity (%), rainfall (mm) and sunshine (hrs.) were worked out and presented here as following.

Rice Yellow stem borer (*S. incertulas*)

The incidence of *S. incertulas* and correlation was worked out to find out the relationship between per cent dead heart and weather parameters. The results showed a significant positive correlation with relative humidity (r=0.589*) whereas, non-significant positive correlation with Minimum temperature (r=0.402), maximum temperature (r=0.106), rainfall (r=0.492) and sunshine (r=0.063). However, the relationship between the per cent white ears and weather parameters showed that there is positive non-significant correlation with sunshine (r=0.482). Whereas, negative and non-significant correlation with minimum temperature (r=-0.356), Maximum temperature (r=-0.032), Relative humidity (r=-0.357) and Rainfall (r=-0.347). Present findings are in agreement with Dalvi *et al.* (2021) [23] reported the population of stem borer showed positive significant correlation with morning and evening relative humidity. These findings also supported by Mondal and Mondal (2018) [24] who found that Relative humidity has positive correlation with the population of Rice stem borer.

Table 1: Occurrence of major insect pests on Rice in relation to weather parameters during *Kharif* 2021

SMW	Incidence of Insect Pests					Weather Parameters				
	Yellow stem borer		Leaf folder damage (%)	Gundhi bugs/hill	BPH/hill	Temperature (˚C)		Rainfall (mm)	Relative humidity (%)	Sunshine (hrs.)
	Dead heart (%)	White ear (%)				Min.	Max.			
31	1.10	0.00	2.85	0.00	2.10	26.10	33.20	3.00	76.00	5.90
32	2.63	0.00	3.94	0.00	3.60	26.20	32.20	125.60	85.90	3.40
33	3.93	0.00	7.16	0.00	4.40	26.20	33.80	18.80	80.80	5.40
34	4.70	0.00	10.85	0.00	5.10	25.50	32.20	24.60	87.80	2.60
35	6.51	0.00	12.01	0.00	6.80	26.10	32.70	1.00	81.20	5.50
36	8.24	0.00	16.25	2.40	8.50	26.20	33.70	42.40	79.40	3.90
37	7.43	0.00	10.32	4.80	9.30	25.50	32.10	20.60	78.80	4.40
38	11.95	0.00	11.20	9.70	10.8	25.00	31.20	41.40	85.80	6.10
39	13.02	0.00	10.07	10.30	6.90	25.10	32.20	63.00	84.50	7.30
40	16.48	0.00	11.21	6.20	7.20	24.50	32.70	82.80	86.10	8.10
41	0.00	16.75	8.02	4.50	1.60	24.00	34.00	0.00	79.50	9.00
42	0.00	18.12	6.22	3.80	0.00	23.60	31.80	24.00	81.30	6.90
43	0.00	17.99	3.15	4.00	0.00	18.20	31.10	0.00	68.00	6.50
44	0.00	0.00	1.31	1.50	0.00	15.00	29.70	0.00	68.30	6.60

SMW= Standard Meteorological Weeks

Table 2: Relationship between of insect pests on Rice and weather parameter during *Kharif* 2021

Insect Pests		Weather Parameters				
		Temperature (˚C)		Relative Humidity (%)	Rainfall (mm)	Sunshine (hrs.)
		Min.	Max.			
Yellow stem borer	**Dead Heart (%)**	0.402	0.106	0.589*	0.492	0.063
	White Ear (%)	-0.356	-0.032	-0.357	-0.347	0.482
Leaf folder		0.586*	0.437	0.577*	0.163	-0.190
Gundhi Bug		-0.037	-0.207	0.210	0.205	0.417
BPH		0.588*	0.207	0.581*	0.334	-0.286

***Correlation is significant at 0.05 level.**

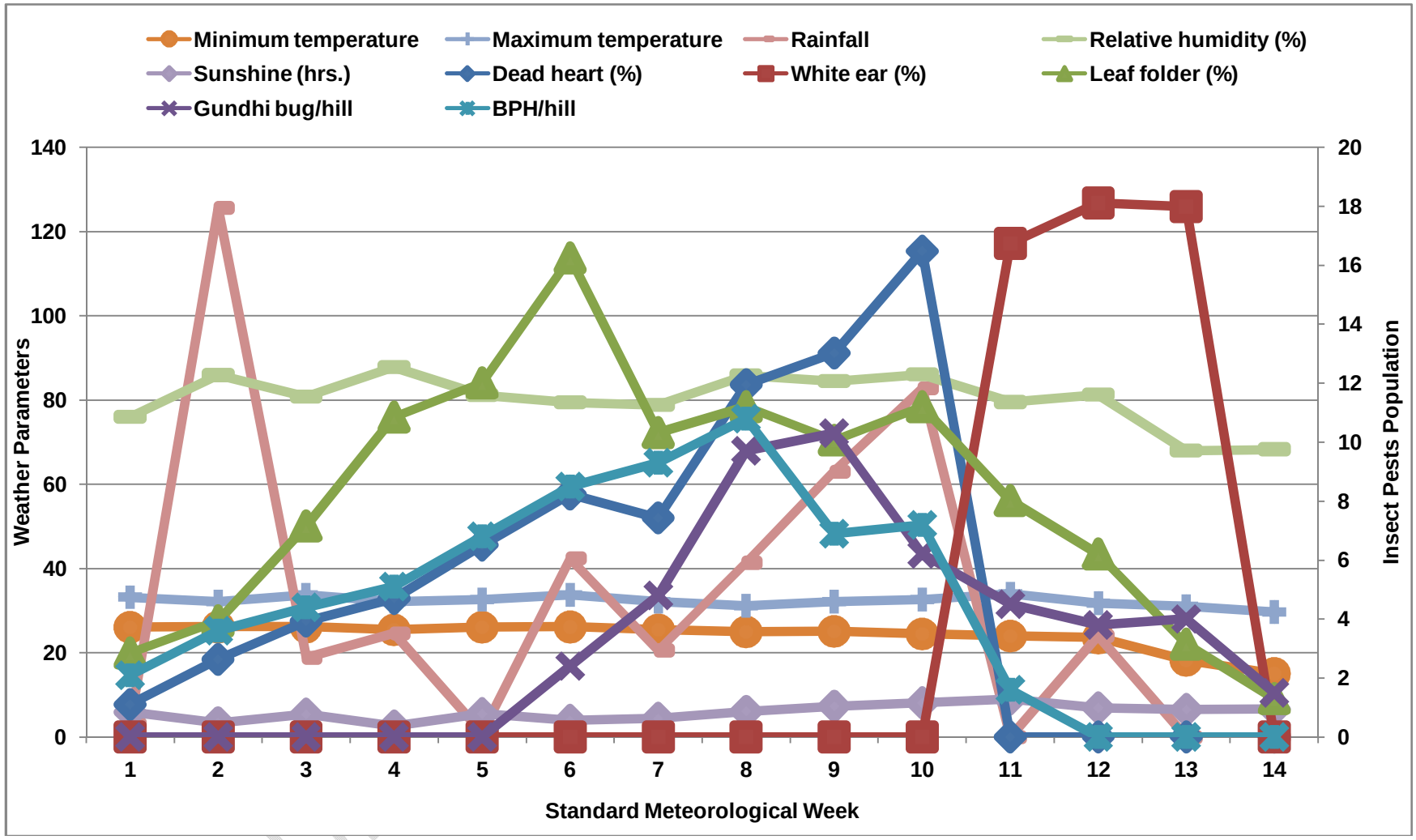

Figure 1: Occurrence of major insect pests on Rice in relation to weather parameters during *Kharif* 2021

Rice Leaf folder (*C. medinalis*)

The incidence of leaf folder showed significant positive correlation with minimum temperature (r=0.586*) and relative humidity (r=0.577*). Whereas, positive and non-significant correlation with maximum temperature (r=0.437) and rainfall (r=0.163). However, negative and non-significant correlation with sunshine (r=-0.190). The current findings are agreement with Chakraborty and Deb (2011) [25] who found that abiotic condition such as minimum temperature relative humidity had significant positive influence on *C. medinalis* population. The present findings are similar to Kakde and Patel (2015) [19] reported that the leaf folder population showed non-significant positive correlation with maximum temperature (r=0.133) and rainfall (r=0.256).

Rice Gundhi bug (*L. acuta*)

The incidence of *L. acuta* showed a non-significant positive correlation with relative humidity (r=0.210), rainfall (r=0.205) and sunshine (r=0.417). However, non-significant negative correlation with minimum temperature (r=-0.037) and maximum temperature (r=-0.207). The present findings are agreement with Khare *et al.* (2020) [26] who reported that Relative humidity was only having positive impact on the Gundhi bug population whereas the rest of the weather parameters shown negative impacts on the Gundhi bug population. These finding also supported by Sharma *et al.* (2018) [21] found that *L. acuta* population showed negative non-significant correlation with minimum temperature.

Brown plant hopper (*N. lugens*)

The incidence of *N. lugens* showed significant positive correlation with minimum temperature (r=0.588*) and relative humidity (r=0.581*). However, non-significant positive correlation with maximum temperature (r=0.207) and rainfall (r=0.334). Whereas, non-significant negative correlation with Sunshine (r=-0.286). The present results are agreement with Patil *et al.* (2020) [27] found the incidence of BPH showed significant negative correlation with rainfall (r=-0.488), morning relative humidity (r=-0.614) and positive correlation with maximum temperature. These findings are also strongly supported by Dipak *et al.* (2020) [28] the population of Brown plant hopper and weather parameters showed a significant positive correlation with maximum (r =0.514*), minimum (r=0.541*) and average (r=0.526*) temperature and morning relative humidity (r=0.578*) during 2016. Whereas it was showed significant positive correlation with morning (r=0.559*), evening (r=0.613*) and average (r=0.530*) relative humidity.

4. CONCLUSION

The present investigation revealed that the highest and lowest Rice Yellow stem borer incidence was recorded at vegetative stage in the form of dead heart at 31st SMW and 40th SMW i.e., 1.10% and 16.48%, respectively, whereas at reproductive stage the highest incidence and lowest incidence was recorded in the form of white ear at 42nd SMW and 41th SMW i.e., 18.12% and 16.75%, respectively. The highest Rice leaf folder incidence was recorded in 36th SMW (16.25%) and lowest in 44th SMW (1.31%). The highest and lowest Rice Gundhi bug mean population was recorded in 39th SMW and 44th SMW i.e., 10.30 and 1.31 bugs/hill, respectively. The highest and lowest BPH mean population was recorded in 38th SMW and 41st SMW i.e.,10.80 BPH/hill and 1.60 BPH/hill, respectively. The yellow stem borer showed significant positive correlation with relative humidity whereas, non-significant positive correlation with minimum temperature, maximum temperature, rainfall and sunshine. Rice leaf folder population showed significant positive correlation with minimum temperature and relative humidity. Whereas, positive and non-significant

correlation with maximum temperature and rainfall. However, negative and non-significant correlation with sunshine. Gundhi bug showed a non-significant positive correlation with Relative humidity, Rainfall and sunshine. However, negative and non-significant correlation with minimum temperature and maximum temperature. BPH population showed significant positive correlation with minimum temperature and relative humidity, however positive and non-significant correlation with maximum temperature and rainfall. Whereas, negative and non-significant correlation with Sunshine. The information generated in the present investigation may be used for the formulation of suitable management strategies against major insect pests of rice.

CONSENT (WHERE EVER APPLICABLE)

Not applicable

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Not applicable

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