SINET: *Ethiop. J. Sci.*, 27(2):165–170, 2004

ISSN: 0379–2897

Short communication

A STUDY ON LIGHT TRAP CATCHES OF SOME RICE PESTS IN RELATION TO METEOROLOGICAL FACTORS

M.K. Sharma [1], **V. Pandey** [2], **R.S. Singh** [2] and **R.A. Singh** [2]

[1] Department of Statistics, Faculty of Science, Addis Ababa University, PO Box 1176 Addis Ababa, Ethiopia. E-mail: kumarmahendra@sancharnet
[2] Crop Research Station, Masodha, N.D.U.A. and Technology, Faizabad 224133, India

ABSTRACT: The effect of meteorological factors on the population build up of green leafhopper *Nephotettix virescens* Dist (Cicadellidae, Hemiptera), plant hoppers *Cofana spectra* Dist (Delphacidae, Hemiptera) and *C. yasumatsui* Young (*Kolla mimica*, Hemiptera) and rice gundhi bug *Leptocoriza acuta* Thunberg (Alydidae, Hemiptera) in rice growing season (July to November) was studied through light trap collection during ten years (1988–1997). Maximum populations of *Nephotettix virescens* Dist (Cicadellidae, Hemiptera) and *C. yasumatsui* Young (*Kolla mimica*, Hemiptera) were recorded in the third week of October during all the years. *Cofana spectra* Dist had maintained peak activity in respect of population in the last week of September and third week of October. *Leptocoriza acuta* Thunberg (Alydidae, Hemiptera) had maximum population in second and third weeks of October during the aforesaid period. No meteorological factors have significant effect on the population build up of *Nephotettix virescens* Dist, *Cofana spectra* Dist and *C. yasumatsui* Young in the month of October. In the case of *Leptocoriza acuta* Thunberg, no other factor but rainfall had positive correlation of order 0.857 with population build up in the fourth week of September.

Key words/phrases: Meteorological factors, path analysis, regression analysis, rice insect pests

INTRODUCTION

Green leafhopper *Nephotettix virescens* Dist (Cicadellidae, Hemiptera) and plant hoppers *Cofana spectra* Dist (Delphacidae, Hemiptera) and *C. yasumatsui* Young (Kolla mimica, Hemiptera) are important insect pests of rice (*Oriza sativa*). These insects are serious pests in Asia, where not only cause direct damage by removing plant sap, but also act as vectors of rice virus diseases, such as rice tungro virus. Rice gundhi bug *Leptocoriza acuta* Thunberg (Alydidae, Hemiptera) is the most important insect pest in rice growing areas of India especially in state of Uttar Pradesh (U.P.). This is a serious pest of rice and can reduce yield by as much as 30%. Rice bug nymphs are more destructive than the adults. They prefer grains at milky stage. Rice bugs damage rice by sucking out the contents of developing grains from pre flowering spikelets to soft dough stage. Both nymphs and adults feed on grains at the milky stage. Such grains remain empty or only partially filled. The panicles in heavy infested fields contain many shriveled and unfilled grains and usually remain erect. An infested field can be recognized by the rice bugs severe odour. Adults are active in the late afternoon and early morning, resting in the shaded areas (Pathak, 1977).

The estimated losses caused by insects are about 31.5% in Asia and 2%, in Europe. The importance of agricultural pests is indicated by the fact that only a 10% increase or decrease in food grain production, on global scale, can make the difference between a glut and acute scarcity (Heinrichs, 1998). Meteorological factors play an important role in seasonal abundance, distribution and population build up of insect pests. It is difficult to find direct cause and effect relationship between any single factor and pest activity because the impact of meteorological factor on pests is usually compounded (Garg and Sethi, 1980; Krishnaiah *et al.*, 1996; Harinkhere *et al.*, 1998). Abiotic factors affect the light trap of the insect directly and indirectly. Bhatnager and Saxena (1999) reported that minimum temperature played an important role in the population build up of green leafhopper and rice gundhi bug, besides evening relative humidity and rainfall. Verma *et al.* (1982) reported that the effect of meteorological factors viz. temperature, relative humidity and rainfall found to be non significant and of short nature only in case of *Heliothis armigera* Hubn. Persson (1976) reported that the meteorological parameters have a long term and permanent effect in insect population. Pathak (1977) reported that when temperature declined from October onward, the population of rice gundhi bug was at a peak during September to October.

The present study was undertaken to find out the influence of meteorological parameters namely temperature (maximum and minimum), rainfall and relative humidity on light trap catches of aforesaid insect pests so that active period may be ascertained for controlling them in the field condition to avoid the loss to the rice crop caused by them.

MATERIALS AND METHODS

A chinsura type light trap (Chinsura Rice Research Station, India), fitted with 200-watt electric bulb, is an indigenous device. It had been installed long ago at the Crop Research Station (formerly Rice Research Station), Masodha, N.D., University of Agriculture and Technology, Faizabad, (U.P.), India, to predict outbreaks of pest species and to assist farmers in making decision for management of the pest. A wooden box containing killing bottle having plaster of paris and potassium cyanide is placed under the bulb. The insects that circle around the bulb drop in the wooden box and they are counted in the morning.

Thus trap catches of green leafhopper *Nephotettix virescens*, planthopper *Cofana spectra* and *C. yasumatsui* and rice gundhi bug *Leptocoriza acuta* have been recorded daily during rice growing season from July to November during 1988–1997 along with daily observations of meteorological variables, viz. temperature (maximum and minimum), rainfall, and relative humidity. These observations were compiled and arranged per weeks and weekly averages were recorded. After this the observations were pooled for 10 years. Then regression analysis was applied separately taking each insect pest as dependent variables and meteorological variables as independent variables to know the effect of independent variables in each week on each insect pest. To know the direct and indirect effects of meteorological variables on trap catches, path analysis was also done following Dewey and Lu (1959).

RESULTS AND DISCUSSION

Four pest species of rice (green leafhopper *Nephotettix virescens,* plant hopper *Cofana spectra, C. yasumatsui*, and rice gundhi bug *Leptocoriza acuta)* appeared in light trap catch during rice growing seasons from July to November during 1988–1999. The populations build up of insect pests through trap collections are presented in Figures 1, 2 and 3.

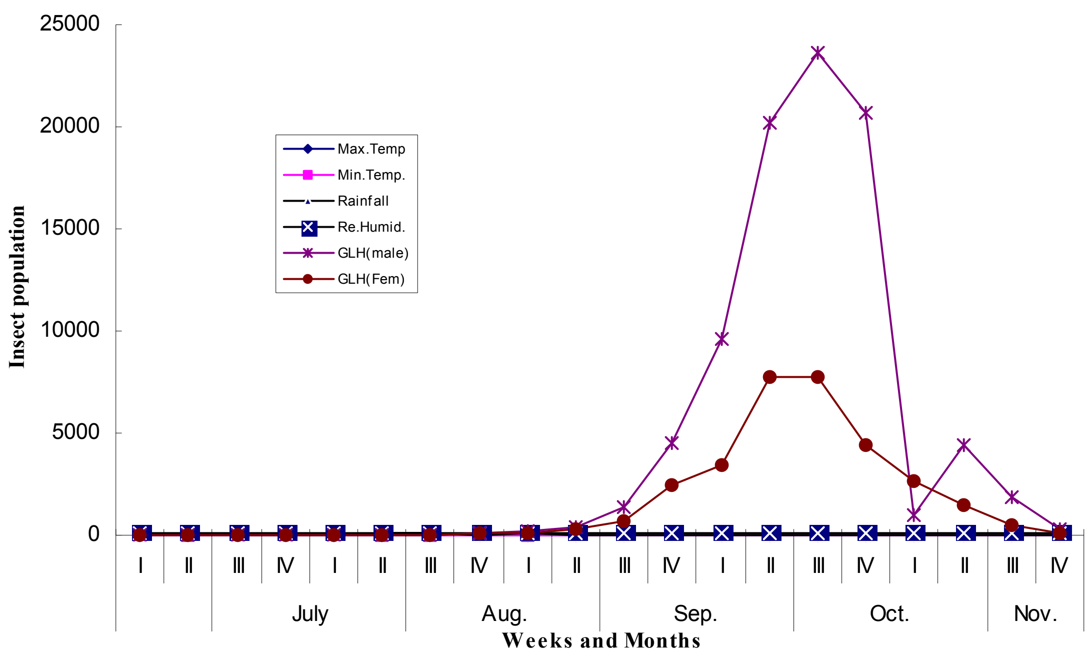

Fig. 1. Population of green leafhoper *Nephotettix virescens* Dist (Male and Female).

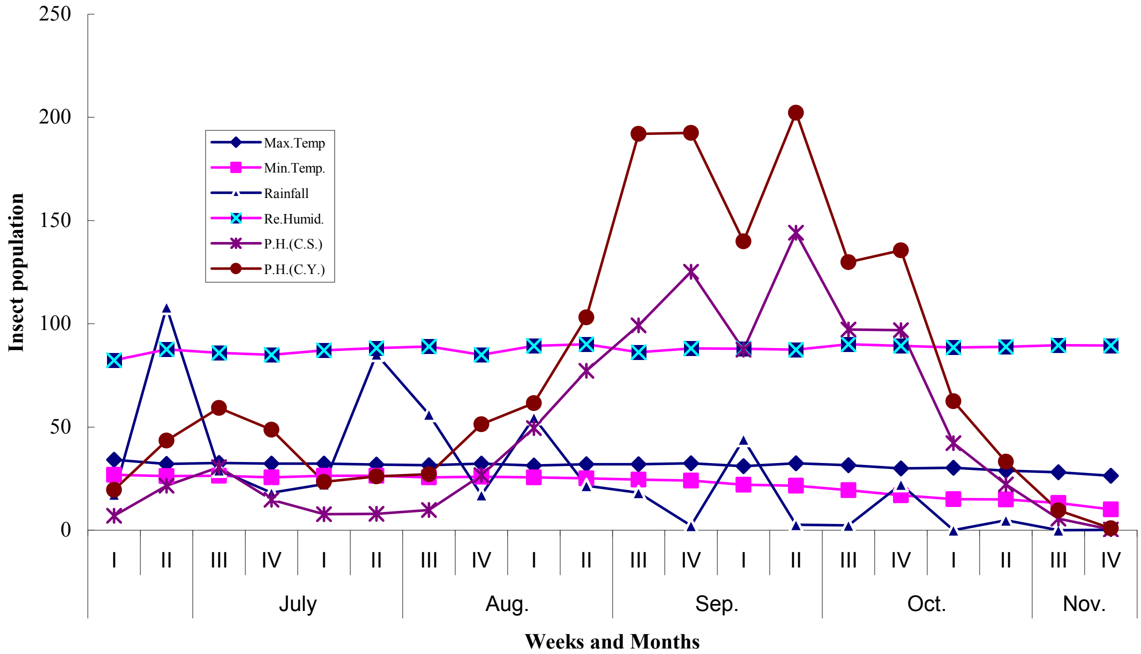

Fig. 2. Population of plant hopper *Cofana spectra* Dist and *C. yasumatsui* Young

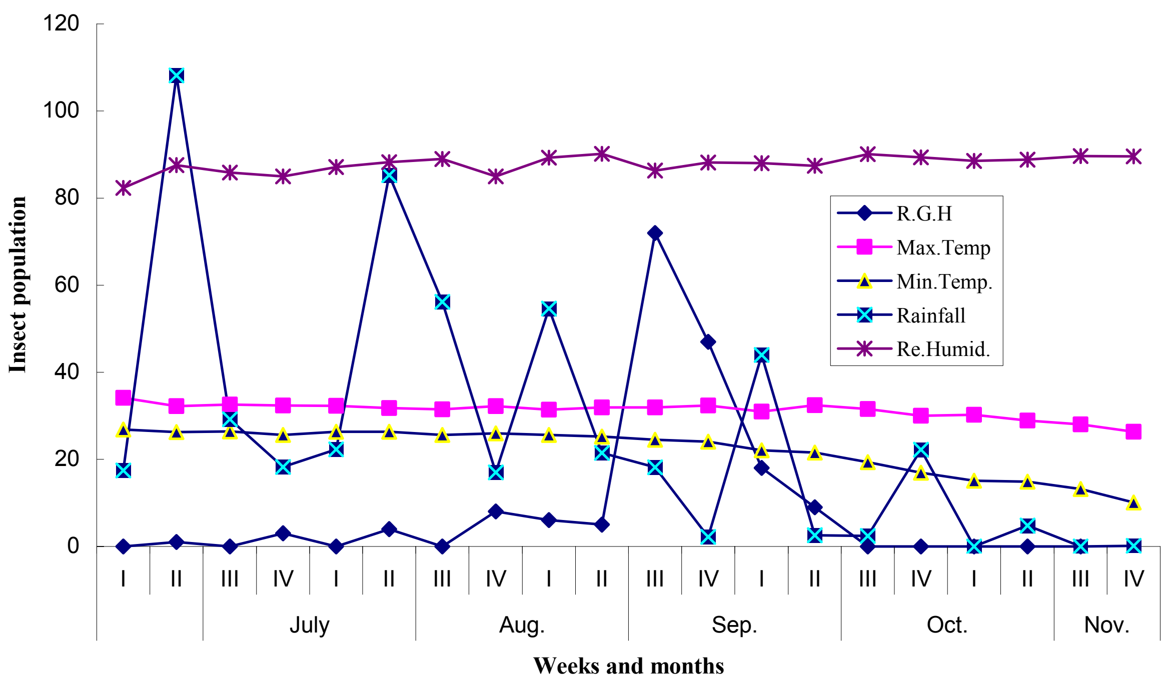

Fig. 3. Population of rice gundhi bug *Leptocriza acuta* Thunberg.

The multiple regression analysis did not yield any significant results in the case of green leafhopper and plant hopper. In the case of rice gundhi bug multiple regression and path analysis yielded significant result on population build up of this insect due to meteorological variables.

1. Green leafhopper *Nephotettix virescens:* Maximum population was recorded during the third week of October. Meteorological parameters had no significant effect with population build up. Path analysis (Table 1) revealed that the direct contribution of maximum temperature and rainfall on population build up of male green leafhopper was negative (–0.9893 and –0.8951). But, indirect contribution of rainfall through maximum temperature on population build up was 0.623. Similarly indirect contribution of maximum temperature through rainfall was 0.6886. These indirect contributions made correlations of maximum temperature and rainfall with population build up insignificant (–0.293 and 0.064). Similarly, maximum temperature and rainfall were contributing (directly negative and indirectly positive) in the case of female green leafhopper's population build up. Therefore it can be concluded that when maximum temperature was contributing negatively then rainfall was contributing indirectly positively in population build up of both males and females and vice versa. Minimum temperature and relative humidity contributed positively (0.3528 and 0.7511) in population build up of male green leafhopper. Though, the indirect contribution of minimum temperature was also positive (0.4937), the indirect negative contribution of rainfall (–0.4520) and relative humidity (–0.1374) made both direct and indirect effects of minimum temperature ineffective. It yielded low correlation (0.257) of minimum temperature with population build up of male green leafhopper. Similarly, the effect of positive contribution of relative humidity became ineffective due to negative indirect effects of maximum temperature, minimum temperature and rainfall. Relative humidity yielded low correlation (0.248) with population build up. In the case of female green leafhopper, the direct contribution of rainfall was –0.5109, which became ineffective by the positive indirect contribution of maximum temperature (0.3993), minimum temperature (0.0749), and relative humidity (0.0037). The residual values in path analysis were 0.6383 and 0.8964 in case of green leafhopper's respectively. The reason seems to be very low and non-significant correlations of meteorological factors with population build up of both males and females, suggesting that some more important parameters are needed for further study.

2. Plant hopper *Cofana spectra:* High population of plant hopper was recorded in fourth week of August and third week of October and it was found that meteorological parameters do not play any significant role in the population build up. Path analysis (Table 2) revealed that minimum temperature contributed positively (0.8004 and 0.4227) in the fourth week of August and third week of October on the population build up of said pest. But these positive contributions became ineffective through the negative indirect contribution of maximum temperature, rainfall and relative humidity in the fourth week of August and also due to positive effect of maximum temperature and negative effects of rainfall and relative humidity in third week of October. With the result minimum temperature got low correlation (0.369) and (0.166), respectively, with population build up. Relative humidity had direct negative contribution (–0.6361) in the fourth week of August on population build up through indirect effects of maximum temperature (–0.0177), minimum temperature (0.3394) and rainfall (0.0305) and positive direct effect (0.6831) in third week of October through negligible negative direct effects with all the three factors. This resulted in insignificant correlation (–0.284 and 0.382) of relative humidity with population build up during both the weeks. Thus the contribution of relative humidity was negative in the fourth week of August and positive in the third week of October in population build up. In the third week of October the contributions of maximum temperature and rainfall were –0.5328 and –0.7873, respectively, on population build up, which became ineffective by positive indirect effects of rainfall and relative humidity (0.5480 and 0.2267) and positive indirect effects of maximum temperature and minimum temperature (0.3708 and 0.2134), respectively. This yielded non-significant correlations of maximum temperature (0.031) and rainfall (–0.199) with population build up. Therefore maximum temperature and rainfall played negative role in population build up of plant hopper in the month of August and October respectively. The residual effect was 0.7519 suggesting that some more parameters are needed for further investigation.

Table 1. Correlations, direct (bold) and indirect effects of meteorological variables on population build up of green leafhopper male and female (in bracket) in third week of October.

Meteorological Variable	Correlations of population build up with meteorological variables	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall	Relative humidity
Max. temp.	–0.293 (–0.282)	**–0.9893 (–0.5737)**	–0.1761 (–0.0740	O.6236 (0.2494)	0.2494 (0.010)
Min. temp.	0.257 (0.182)	0.4937 (0.2862)	**0.3528 (0.1483)**	–0.4520 (–.2580)	–0.1374 (0.0055)
Rainfall	0.064 (–0.033)	0.6886 (0.3993)	0.1782 (0.0749)	**–0.8951 (–0.5109)**	0.0923 (0.0037)
Relative Humidity	–0.3284 (–0.1904)	–0.0645 (–00.0271)	–0.1101 (-0.0628)	0.7511 (-0.0304)	**0.248 (-0.25)**

Table 2. Correlations, direct (bold) and indirect effects of meteorological variables on population build up of Plant hopper *Cofana spectra Dist* in fourth week of August and third week of October (in bracket).

Meteorological Variable	Correlations of population build up with meteorological variables	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall	Relative hu-midity
Max. temp.	-0.34 (0.031)	**-0.2168 (-0.5328)**	0.2922 (-0.2109)	-0.572 (0.5480)	-0.0522 (0.2267
Min. temp.	0.369 (0.166)	-0.0791 (0.2658)	**0.8004 (0.4227)**	-0.0825 (-0.3976)	-0.2697 (-0.1250)
Rainfall	-0.317 (-0.199)	0.0800 (0.3708)	-0.4266 (0.2134)	**0.1549 (-0.7873)**	-0.1253 (0.0840)
Relative humidity	-0.284 (0.382)	-0.0177 (-0.1769)	0.3394 (-0.0773)	0.0305 (-0.0968)	**-0.6361 (0.6831)**

3. Plant hopper *C. yasumatsui:* High population of plant hopper was recorded during the third week of October and it was found that meteorological variables did not play any significant role in population build up of this insect. Path analysis (Table 3) revealed that maximum temperature, rainfall and relative humidity had direct negative contributions (–0.2725, –0.2795 and –0.0674) on the population build up of this insect. Minimum temperature, rainfall, and relative humidity had negligible indirect effects on population build up. While minimum temperature contributed positively (0.2498) on the population build up of this insect, but it became ineffective through positive indirect effects of maximum temperature and relative humidity (0.1359 and 0.0123) and negative direct effects of rainfall (–0.1411). Thus no meteorological factor was playing any significant role in population build up of this insect suggesting that some more factors are needed for further investigation.

4. Rice gundhi bug *Leptocoriza acuta*: Regression analysis revealed that the population build up of rice gundhi bug had positive significant correlation (0.857) with rainfall in the fourth week of September. The regression equation is given below along with standard error in brackets, coefficient of determination (R^2), the multiple correlations (R), and calculated 't' value.

$$\text{Y (population)} = 40.572 + \underset{(1.061)}{1.676}\,(\text{max. temp.}) - \underset{(0.402)}{0.259}\,(\text{min. temp}) + \underset{(0.051)}{2.971}\,(\text{rain fall}) - \underset{(0.580)}{1.065}\,(\text{humidity})$$

R^2 = 0.858, R =0.926, 't' value=19.707, P=0.01

Table 3. Correlations, Direct (bold) and indirect effects of meteorological variables on population build up of Plant hopper *C. yasumatsui* Young third week of October.

Meteorological Variable	Correlations of population build up with meteorological variables	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall	Relative humidity
Maxi. temp.	-0.225	**-0.2725**	-0.1246	0.1945	-0.0223
Mini. temp.	0.257	0.1359	**0.2498**	-0.1411	0.0123
Rainfall	0.028	0.1896	0.1262	**-0.2795**	-0.0082
Relative humidity	-0.238	-0.0904	-0.0457	-0.0303	**-0.0674**

Path analysis (Table 4) revealed that rainfall had positive contribution (0.92) on population build up of rice gundhi bug through negligible indirect contributions of maximum temperature (–0.1531), minimum temperature (0.033) and relative humidity (0.051) which yielded significant correlation with population build up.

Path analysis revealed that rainfall contributed in population build up of rice gundhi bug, but maximum temperature played negative role. The direct positive effect of maximum temperature on population build up was made ineffective through negative effect of rainfall. Therefore, it can be concluded that rainfall and maximum temperature played important role in population build up of rice gundhi bug. The residual in path analysis was found to be low 0.3367. In the present study the peak activity of rice gundhi bug was found during the month of September.

Table 4. Correlations, Direct (bold) and indirect effects of meteorological variables on population build up of rice gundhi bug in fourth week of September.

Meteorological Variable	Correlations of population build up with meteorological variables	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall	Relative humidity
Max. temp.	-0.132	**0.3381**	-0.0398	-0.4167	-0.0314
Min. temp.	0.318	0.0456	**-0.2951**	-0.1030	0.0345
Rainfall	0.857**	-0.1531	0.0330	**0.9200**	0.0510
Relative humidity	0.480	-0.0459	-0.1030	0.5299	**0.0992**

ACKNOWLEDGEMENTS

We are very grateful to referees for their constructive comments and suggestions and also to Prof. Bala Krishnan, Addis Ababa University, Addis Ababa, Ethiopia for his guidance in preparation of the revised manuscript.

REFERENCES

1. Bhatnager, A. and Saxena, R.R. (1999). Environmental correlates of population build up of rice insect pests through light trap catches. *Oryza.* **36**(3):241–245.
2. Dewey, D.R. and Lu, K.H. (1959). A correlation of components of crested wheat-grass seed production. *Agron.* **51**:515–518.
3. Garg, A.K. and Sethi, G.R. (1980). Succession of insect pests in *Kharif* Paddy. *Indian J. Ent.* **2**:482–487.
4. HarinKhere, J.P., Kanadalkar, V.S. and Bhowmick, A.K. (1998). Seasonal abundance and association of light trap catches with field incidence of rice leaf folder, *Cnaphalocrocis medinalis* Guenee. *Oryza.* **35**:91–92.
5. Heinrichs, E.A. (1998). *Management of Rice Insect Pests*, Department of Entomology, University of Nebraska Linncoln, Nebraska.
6. Krishnaiah, K., Pasalu, I.C., Krishnaiah, N.V. and Bentur, I.C. (1996). Integrated pest management in rice. **In**: *Plant Protection and Environment*, pp. 94–104, (Reddy, D.V.S., ed.) Plant Protection Association of Indian, Hyderabad, India.
7. Pathak, M.D. (1977). *Grain Sucking Insects*. *Insect pests of rice*. International Rice Research Institute, Los Banos, Philippines, pp. 27–32.
8. Persson, B. (1976). Influence of weather and nocturnal illumination on the activity and abundance of Noctuids: Lepidoptera in South Coastal Queens land. *Bul. Ent. Res.* **66**:33–63.
9. Verma, R., Vaishampayan, S.M. and Rawat, R.R. (1982). Influence of weather factors on the light trap catches of *Heliothis armigra* (Hubn). *Indian J. Ent*. **44**(3):213–218.