

Population fluctuation of planthoppers and their predators in rain-fed rice

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ABSTRACT

Studies undertaken at Central Rice Research Institute (CRRI), Cuttack and in farmers' field at Kandbindha, Dhenkanal during wet season indicated that mixed population of BPH and WBPH occurred in the field and among spiders *Tetragnatha mandibulata* was the dominant species. Population of planthoppers was low both at CRRI and Kandabindha during wet season of 2003-04. Population of spiders and the green mirid bug *Cyrtorhinus lividipennis* initially were at par with each other but the latter overtook the former in the second week of October and maintained the trend till the end. During wet season 2004-05 at CRRI the hopper population reached the peak level of 42 hoppers hill⁻¹ in the first week of October. Population of spiders and *C. lividipennis* started concurrently along with the appearance of hoppers in the farmer's field at Kandabindha. Between the two predators, population of spiders fluctuated throughout the period of study. During both the years and at both the sites of trial the population of spiders was always lower than that of *C. lividipennis*. Under rain fed ecosystem, besides natural enemies, precipitation appears to play an important role in reducing the hopper population. Analysis of ratio of planthoppers to both the predators combined indicated that it was 4.5 and 2.5 in the beginning of hopper infestation and reached the maximum level of 23.9 and 12.4 and declined to 1.8 and 2.4 during 2004 at CRRI and Kandabindha, respectively.

Key words: rice, brown planthopper, white backed planthopper, predator, population

Control of insect pests is a major problem for many rice farmers in India and is one of the major constraints in the realization of optimum yield. Among these, planthoppers are the most important among sucking pests. Several species of planthoppers are found in India of which brown planthopper (BPH), *Nilaparvata lugens* Stal, and the white backed plant hopper (WBPH), *Sogatella furcifera* Horvath cause major economic loss to the crop. These hoppers remain at the base of the plant and feed on plant sap. Biotic and abiotic factors influence field populations of insect pests of rice. Among the biotic factors egg parasitism and general predation are known to be important mortality factors in the population dynamics of rice brown planthopper in tropical Asia (Claridge *et al.*, 2002). *Cyrtorhinus lividipennis* Reuter is one of the important predators exerting control effects on population build up of BPH, WBPH and GLH (Martin, 1986). Spiders are an integral part of rice ecosystem and different species have been reported to prey on different pest species, especially brown planthopper

(BPH) and have been recognized as one of its important natural enemies that keep its population well below the economic threshold level. Farmers in Orissa use low quantity of pesticides, 103 g ha⁻¹ as against the national consumption level of 288 g ha⁻¹ (Agnihotri, 2000) and in wet season rice it is still lower. Under such circumstances natural biological control plays an important role in restricting the population of the pests. Studies on population fluctuation are essential for the comprehension of predator-prey relationships in agroecosystems and the role of natural enemies in regulation of population of herbivorous insects. Predators like spiders and mirid bugs play an important role in population build up of both the planthopper species. Very limited work has been done, especially in India on the population studies of planthoppers vis-à-vis their predators under field conditions. Therefore, the present work aims to investigate aspects of population fluctuation of both the planthoppers and their predators viz. *Cyrtorhinus lividipennis* Reuter and several species of spiders.

Experiments were undertaken to collect data on population build up of planthoppers and their predators in the experimental plots of Central Rice Research Institute (CRRI), Cuttack and farmers' field at Kandabindha, Dhenkanal district, 70 Km from Cuttack during wet seasons of 2003-04 and 2004-05. Relevant weather data were recorded by automatic micro weather station at CRRI and through digital thermo-hygrometer and rain gauge in the farmers' field which was supplemented with other weather data from the nearest observatory of Indian meteorological department. Twenty five days old seedlings of cv Swarna, susceptible to BPH were transplanted in lines at CRRI at a spacing of 20 x 15 cm and randomly in farmers' field. Standard agronomic practices were followed to raise the crop. Observations were taken at regular intervals under natural infestation by the pest on 100 fixed hills selected randomly in 800 square meter plots along both the diagonals and mid-point to mid-point of the opposite sides of the field. Insecticide was not applied at any stage of the crop.

Mixed population of BPH and WBPH was observed in both the years in the experimental plots at CRRI as well as farmers' fields at Kandabindha. Macropterous forms of WBPH appeared first in the field followed by BPH during wet season whereas in dry season, BPH appeared first followed by WBPH. *S. furcifera* was the dominant species and it constituted 80 to 95% of the total planthopper population. Spider species recorded were *Tetragnatha mandibulata* Walck., *Tetragnatha mandibulata bidentata* Gravely, *Lycosa chaperi* Simon, *Lycosa* sp., *Oxyopes sunandae* Tikader, *Oxyopes* sp., *Argiope catenulata* (Dol.) and *Callitrichia* sp.. Among these *T. mandibulata* was the dominant species. Thirty six species of spiders have been identified as predators of BPH in India of which *Lycosa pseudoannulata* is often the predominant species, and possibly one of the most important predators (Sahu *et al.*, 1996).

Population of planthoppers was low both at CRRI and Kandabindha during wet season of 2004. Except on one sampling date the population was below the threshold level of 10 hoppers hill⁻¹ at CRRI. Populations of spiders and the mirid bug were low initially and attained their peaks after the pest population reached the maximum of 19.4 hoppers hill⁻¹. Population of spiders and the mirid bug *Cyrtorhinus lividipennis*

initially were at par with each other but the latter overtook the former in the second week of October and maintained the trend till the end. With the increase in density of predators, planthopper population decreased slowly and was negligible by the end of October (Fig. 1). During the period of study from 2nd

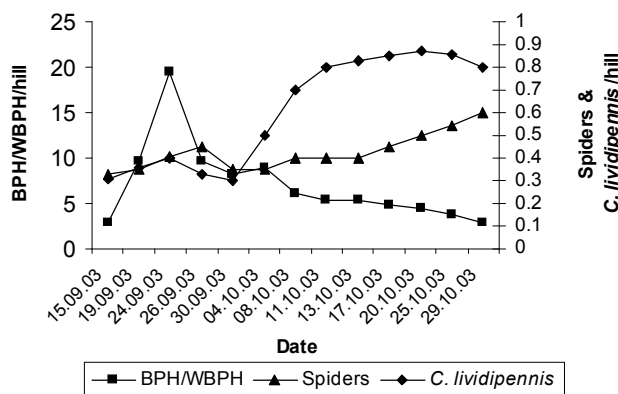


Fig. 1. Population of BPH/WBPH, Spiders & C. lividipennis on var. Swarna at CRRI, Cuttack, wet season 2003

October to 10th October continuous rain was recorded with a total rainfall of 286.2 mm, the highest being 97.8 mm on 7th October. The highest population of hoppers recorded in the farmer's field was 5.6 hoppers hill⁻¹. Spider population was available in the field from the beginning along with the hoppers, whereas *C. lividipennis* appeared late. Population of both the predators reached their first peak before the hopper population reached its peak (Fig.2). Record of rainfall at Kandabindha indicated continuous rain from 2nd October to 7th October with a total rainfall of 206.4 mm. The highest rainfall of 117.1 mm was recorded on 8th October.

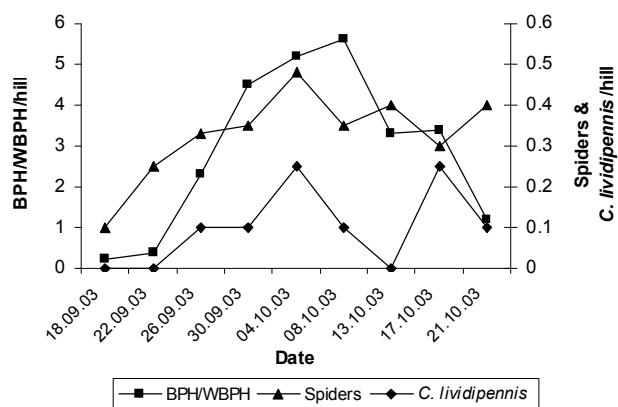


Fig. 1. Population of BPH/WBPH, Spiders & C. lividipennis on var. Swarna at Kandabindha, wet season 2003

During wet season of 2004 population of planthoppers appeared in experimental plots of CRRI as well as farmer's field during last week of August earlier than in wet season of 2003. In the experimental plots at CRRI it reached the peak level of 42 hoppers hill⁻¹ in the first week of October. Spiders were observed soon after the hopper infestation and continued to increase till the end of the experiment even though hopper population declined to the minimum density of 5.5 hoppers/hill (Fig.3). The presence of spiders in the

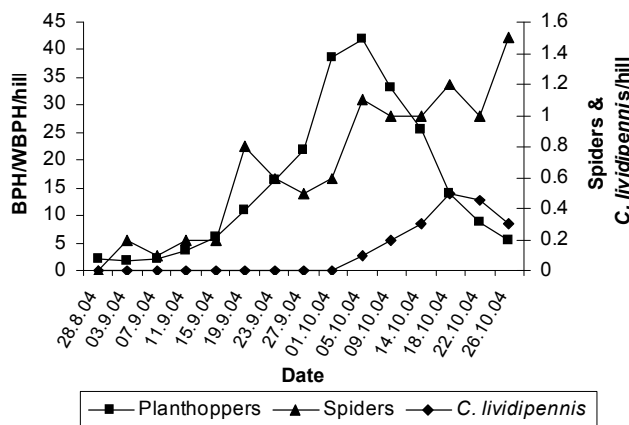


Fig. 3. Population of BPH/WBPH, Spiders & *C. lividipennis* on var. Swarna at CRRI, Cuttack, wet season 2004

field along with hoppers failed to check the population builds up of the latter. Spiders being generalist predators feeding on various preys were not affected by the decline in hopper population whereas *C. lividipennis*, the specific predators of leaf and planthoppers appeared in the field only after the hoppers reached their peak and attained its peak in the third week of October indicating delayed density dependence. Studies undertaken in Chhattisgarh by Indira Gandhi Agricultural University indicated that populations of *Paederus* sp., *Brumus* sp. and *Cyrtorhinus* sp. were density dependent whereas the spider *Lycosa* sp. was density independent. (Anonymous, 1994). Continuous rain was experienced at CRRI farm from 3rd October to 7th October totaling to 195.2 mm with the maximum of 138.3 mm on 5th October which possibly was responsible for decline in hopper population. Population of spiders and *C. lividipennis* started concurrently along with the appearance of hoppers in the farmer's field at Kandabindha. Between the two predators population of spiders fluctuated throughout the period of study. Population of planthoppers increased steadily and

reached its peak (21.6 hoppers hill⁻¹) in the 1st week of October. Population of *C. lividipennis* followed a similar trend but attained the peak with a lag period of 10 days by the end of 2nd week and declined thereafter (Fig.4). Six conjunctive rainy days from 2nd - 7th October

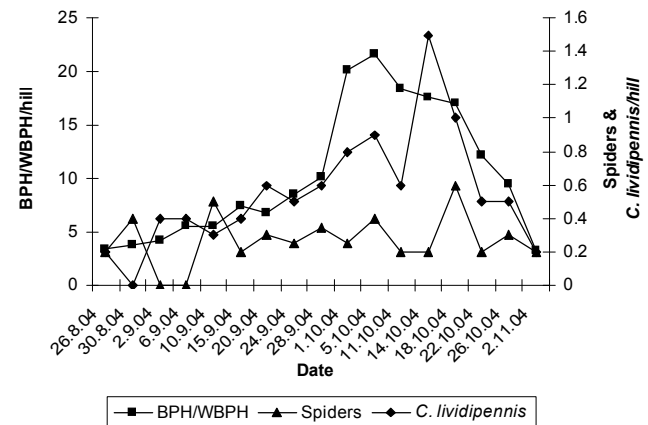


Fig. 4. Population of BPH/WBPH, Spiders & *C. lividipennis* on var. Swarna at Kandabindha, wet season 2004

were observed at Kandabindha with a total rainfall of 107.6 mm that could have contributed also to the decline of hopper population. Population of the mirid bug increased at a faster rate compared to spiders. During both the years and at both the sites of trial the population of spiders was always lower than that of *C. lividipennis*. Under rain fed ecosystem, besides the action of natural enemies, the population of planthoppers was brought down due to intermittent heavy rain, which possibly dislodged the insects from the tillers and subsequently washed away.

Studies on seasonal abundance of the green mirid bug along with prey indicated that the population of planthoppers increased up to the first fortnight of October, and subsequently the predator took the upper hand and by the second fortnight of November the ratio of planthoppers to *C. lividipennis* came down to 1:1.1 from 7:1 in second fortnight of July (Murthy *et al.*, 1976). In the present investigation also the hopper population had an increasing trend up to second fortnight of October but declined to a negligible level before the end of the month due to combine action of predators and precipitation. During wet season planthoppers started appearing in the second fortnight of August and continued usually up to the end of October. Analysis of ratio of planthoppers to both the predators combined

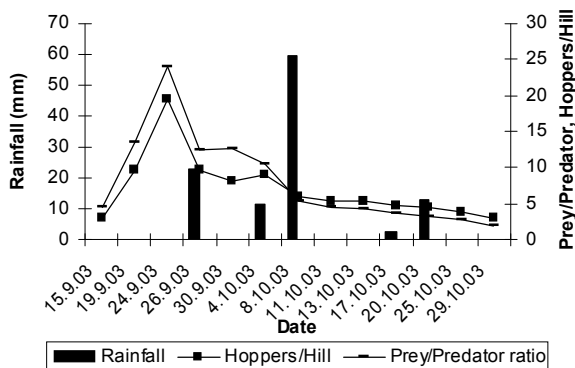


Fig. 5. Prey predator ratio, CRRI, Cuttack wet season 2003-04

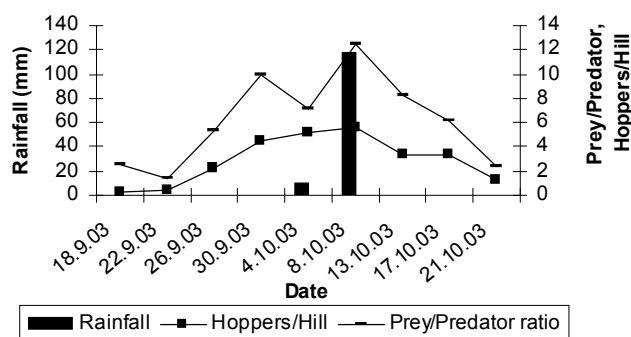


Fig. 6. Prey predator ratio, Kandabindha wet season 2003-04

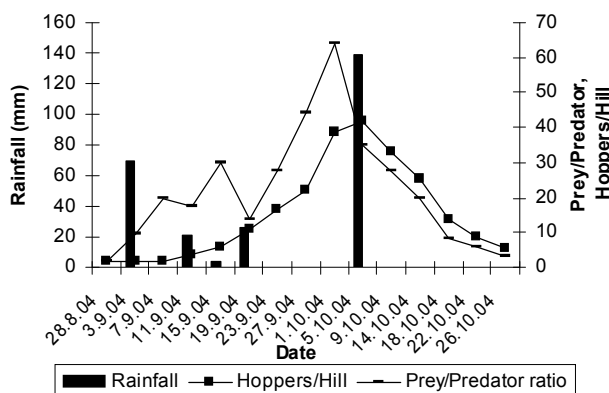


Fig. 7. Prey predator ratio, CRRI, Cuttack wet season 2004-05

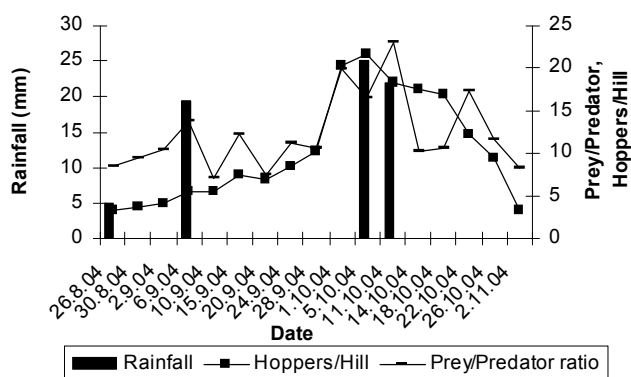


Fig. 8. Prey predator ratio, Kandabindha wet season 2004-05

indicated that it was 4.5 and 2.5 in the beginning of hopper infestation and reached the maximum level of 23.9 and 12.4 and declined to 1.8 and 2.4 during 2003 at CRRI and Kandabindha, respectively. The peak time of hopper population coincided with the peak level of prey predator ratio as the hopper population was low. During 2004, however, the initial prey predator ratio was 9.5 and 8.5 that increased to 64.1 and 23.0 and finally came down to 3.0 and 8.2 5 at CRRI and Kandabindha, respectively. The peak activity of hoppers did not coincide with that of prey predator ratio. It may not be possible for the predators alone to check the population development of planthoppers on susceptible rice variety under favourable weather conditions.

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