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INFLUENCE OF CLIMATIC FACTORS ON POPULATIONS OF THE BROWN PLANT HOPPER IN KUTTANAD, KERALA

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The brown planthopper (bph) *Nilaparvata lugens* (Stal.) (Hemiptera: Delphacidae) has assumed the status of a major pest of rice in recent years in India, Indonesia, Japan, Philippines and Taiwan (Dyck, 1 977). In Kerala, the pest first made its appearance in 1973 in the Kuttanad and *kole* rice tracts causing considerable damage to the crop. Hopper infestation is very closely related with meteorological factors, seasons and timing of cultivation (Alam, 1971; Kulshreshta *et al.*, 1974; Abraham and Nair, 1975; Anonymous, 1975; Dyck *et al.* 1977). In the water-logged Kuttanad area of Alleppey District, Kerala, rice is grown in extensive areas in two principal seasons as winter and autumn crops. The present paper reports results of studies made on the relation between climatic factors and the population fluctuations of brown plant hopper at Moncompu in Kuttanad during 1974-76.

Materials and Methods

Population of brown plant hopper was measured in terms of counts of the adults caught in a light trap (Rothamsted model) fitted with a 100 watt electric bulb. The meteorological data recorded at the Rice Research Station, Moncompu, were utilised for correlation studies.

Results and Discussion

Two peaks in the population of brown planthopper are in evidence (Fig. 1). The major peak is recorded in January-March which coincides with the booting and post-flowering stages of the main rice crop. Hopper population shows a declining trend by the end of March and this trend continues till the end of July. Thereafter, an increase in population is observed and a second minor peak in the population is observed during August-September when the autumn crop is in the field.

Crop age has been reported to be a contributing factor in the population build up of leaf and plant hoppers. Peaks in the brown plant hopper population most commonly occurs beyond 60 days after transplantation or between the heading and harvesting stages (Hinckiey, 1963, Bae and Pathak, 1969; Pathak and Dyck, 1973; Kalode, 1976). Alam (1971) found that crop age appeared to have highly significant effect on bph population and within a crop season, peaks appeared at or after panicle initiation stage. Two major population peaks within an year synchronising with the maturation of the main crops have been observed at the IRRI (Dyck *et at.* 1977). In the present study also two peaks are observed synchronising with the maturing stages of the winter and autumn crops. However, in the present long term study, the correlation between crop age and population density has not been taken into consideration.

Simple correlations were worked out between the population of brown planthopper and climatic factors (Table 1). Partial correlations between population of bph and each climatic factor after eliminating the other factors individually and jointly were also worked out (Table 2).

Correlation studies have shown that the population of bph is positively correlated with mean maximum temperature (Table 1). Partial correlations (Table 2) show that the positive correlation existing between mean maximum temperature becomes non-significant when the other climatic factors are eliminated jointly. But when minimum temperature alone is eliminated, significant association between population of bph and mean maximum temperature is noticed. These results indicate the combined influence of climatic factors on the population of bph, especially the joint influence of maximum temperature, rainfall and relative humidity. The positive correlation between bph and mean maximum temperature is in agreement with the observation of several workers that high temperatures are associated with high pest numbers (Hoppe, 1973; Bae and Pathak, 1970; Chalermwong, 1975).

Table 1

Correlation coefficients between population of bph and climatic factors

Associations	'r'
1. Population of BPH and maximum temperature	0.4646*
2. Population of BPH and minimum temperature	-0.4409*
3. Population of BPH and relative humidity	-0.4359*
4. Population of BPH and rainfall	-0.5024*

* Significant at 5% level.

The results show a significant negative correlation between population of bph and mean minimum temperature. The partial correlation between population of bph and mean minimum temperature retained the negative trend even after the elimination of all otherfactors jointly.

The population of bph is found to be negatively correlated with relative humidity. The negative relationship between relative humidity on the one hand and population on the other becomes non-significant when the influence of other factors are eliminated individually and jointly. This shows that relative humidity alone has no effect on changes in the population of bph. In general, humid environments

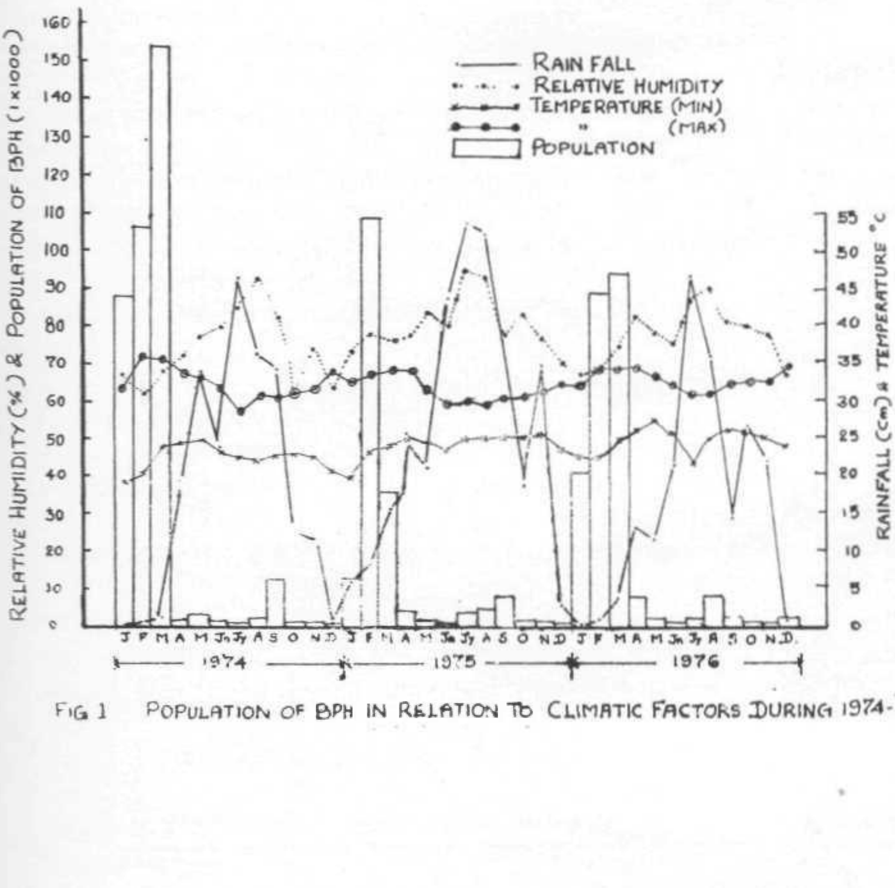

FIG 1 POPULATION OF BPH IN RELATION TO CLIMATIC FACTORS DURING 1974-76

Table 2

Partial correlations between population of bph and climatic factors

	Associations	V
1	Population of BPH and maximum temperature eliminating all other factors	0.2756
2	Population of BPH and maximum temperature eliminating minimum temperature only	0,4904*
3	Population of BPH and maximum temperature eliminating RH only	0.2837
4	Population of BPH and maximum temperature eliminating rainfallonly	0.1457
5	Population of BPH and minimum temperature eliminating all other factors	-0.4072*
6	Population of BPH and minimum temperature eliminating maximnm temperature only	-0.4689*
7	Population of BPH and minimum temperature eliminating RH only	-0.3261
8	Populatlon of BPH and minimum temperature eliminating rainfall only	-0.3480*
9	Population of BPH and RH eliminating all other factors	0.0181
10	Population of BPH and RH eliminating maximum temperature only	-0.2242
11	Population of BPH and RH eliminating minimum temperature only	-0.3186
12	Population of BPH and RH eliminating rainfall only	-0.0742
13	Population of BPH and rainfall eliminating all other factors	-0,6518*
14	Population of BPH and rainfall eliminating maximum temperature only	-0.2588
15	Population of BPH and rainfall eliminating minimum temperature only	-0.4294*
16	Population of BPH and rainfall eliminating RH only	-0.2857

* Significant at 5% level,

have been reported to be conducive to bph development and multiplication (Ngoan, 1971; Hoppe, 1973; Chalermwong, 1975; Narayanaswamy, 1975). In the present study, the peak population is observed when the relative humidity fluctuated within median level of 60-70 per cent.

The results also show a significant negative correlation between population of bph and rainfall. This negative correlation remain unchanged even after the elimination of other weather components jointly indicating that rainfall plays a decisive role in regulating bph population. Heavy rainfall has been reported as a factor responsible for significant reduction in bph population (Kulshreshta *et al.*, 1974; Abraham and Nair, 1975; Fernando, 1975; Varca and Feuer, 1976) and low rainfall has been implicated in the population growth of the pest (Bae and Pathak, 1968; Narayanaswamy, 1975; Veluswamy *et al.* 1975). The occurrence of the peak and low population levels in association with low and high rainfall periods respectively of the crop growing season in Kuttanad corroborates the above reports.

When the effects of maximum temperature and relative humidity are independently eliminated, the relation between population of bph and rainfall fails to obtain significance. A strong association between rainfall, relative humidity and maximum temperature is thus indicated.

The climatic factors associated with the highest peak in the population of bph during the experimental period agree closely with the projected trend on the basis of correlation studies. The climatic factors prevailing in Kuttanad from January to March during the years 1974, 1 975 and 1976 were characterised by a low rainfall, moderately low relative humidity around 70 per cent and highest maximum and lowest minimum temperature of 35.5°C and 19.1°C respectively. Abraham and Nair (1975) observed that a moderate rainfall and a relatively low level of relative humidity and wider range of atmospheric temperatures (20°C to 33°C) favoured a rapid multiplication of The pest in winter months. Mochida and Dyck (1 977) suggested that a fairly high temperature and iow rainfall are related to bph outbreak in the tropics. The climatic conditions associated with the highest peak in bph populations in Kuttanad agree with these reports.

In Kuttanad, the favourable climatic conditions coupled with the availability of the susceptible stages of the crop in the field triggered a rapid multiplication of bph during winter months. In the autumn season, on the other hand, the high rainfall and resultant high humidity levels had an adverse effect on bph population eventhough the susceptible stages of the crop were available.

Summary

Studies carried out at the Rice Research Station, Moncompu, Kerala, during 1974-76 showed that in the Kuttanad rice tract, brown plant hopper *Nilaparvata lugens* (Stal.) is present in the field throughout the year with a major population peak during January to March for themain crop (winter crop) and a minor peak during August to September for the second crop (autumn crop).

Correlation studies revealed that the hopper population was significantly influenced by climatic factors. Rainfall in association with relative humidity and and maximum temperature played a decisive role in regulating the population of the insect.

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സംഗ്രഹം

മങ്കൊമ്പു നെൽഗവേഷണ കേന്ദ്രത്തിൽ കുട്ടനാടൻ പ്രദേശങ്ങളിലെ ബ്രൗൺഹോപ്പർ ബാധയുടെ സ്വഭാവം സംബന്ധിച്ച പഠനങ്ങളിൽ (1974–76), പ്രധാന വിളയിൽ ജനുവരി മുതൽ മാർച്ചുവരെയും അടുത്ത വിളയിൽ ആഗസ്റ്റ്—സെപ്റ്റംബർ മാസങ്ങളിലും കീടങ്ങളുടെ സംഖ്യ പാരമ്യത്തിലെത്തുന്നതായി കണ്ടു. സംഖ്യാബലം നിയന്ത്രിക്കുന്ന ഘടകങ്ങളിൽ പ്രാധാന്യമർഹിക്കുന്നത് വർഷപാതം, അന്തരീക്ഷത്തിലെ ബാഷ്പസാന്ദ്രത, താപനില എന്നിവയാണ്.

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