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Short communication

Effect of climatic factors and agronomic practices on brown planthopper (*Nilaparvata lugens*) out-break in the Anuradhapura District, Sri Lanka

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ABSTRACT

Brown Plant Hopper (BPH) damage in rice was the major production constraint prevailed in 1997/98 South-West monsoon season in areas where the extent under rice cultivation was high. A survey was conducted during the later part of the same season to identify the causes for high BPH infestation in the Anuradhapura district. Of the severely damaged crop, 75% was found to be planted early and these crops had been in the ideal vegetative phase when the high temparature, which was at least four degrees higher than that of a normal South-West monsoon season and the humid micro-environment due to heavy rainfall had been the causes for rapid increase of BPH population. Indiscriminate use of insecticides and use of excessively high rates of nitrogen fertilizer as well as seed paddy had been the additional factors favourable for the BPH proliferation.

Key words: Agronomic factors, El-Nino effect, *Nilaparvata lugens*

Rice is the staple food of Sri Lankans and the extent of rice cultivated in the country during 1997/98 South-West monsoon season was 671,225 ha out of which 49,613 ha were reported to be infested with brown planthopper - BPH- *Nilaparvata lugens* (Stal) (Anon 1998). The warm and humid environment prevailing in South-Asian region is highly conducive for insect proliferation and their activity (Youdeowei and Service 1983). Sri Lanka being a small island situated in this region, 8° North of the equator, is environmentally favourable for rapid multiplication of BPH and there are records of out-breaks of this pest during the period from January to March (Azmey 1986, Hidaka 1998). Unlike in the past, the BPH out break that occurred in 1997/98 South-West monsoon had spread quickly to major rice growing districts namely, Ampara, Anuradhapura, Gampaha, Hambantota, Kurunegala, and Polonnaruwa. Total extent under rice cultivation in the Anuradhapura administrative district which includes Mahaweli system "H" in 1997/98 South-West monsoon season was 108,545 ha and it was the highest percentage (16.17%) among all the other districts where rice is the major crop (Anon 1997). Moreover, in the surveys made during January, 1998 in major rice growing districts, staggered rice cultivation was found to be more conspicuous in the Anuradhapura District. This is an ideal situation for studying the impact of climatic factors on BPH population. *El-Nino* phenominon is the impact of a hot water stream in the Pacific ocean close to Peru, on climatic changes in the other parts of the world. There was a significant association between the out break of BPH and the effect of *El -Nino* years, from 1937 to 1989 in Japan (Morishita 1992). However, there is no information regarding the El-Nino effect on population fluctuation of BPH under Sri Lankan conditions. Therefore, Anuradhapura district was selected to study whether the BPH out break in 1997/98 South-west monsoon season has any association with the climatic changes resulted from *El-Nino* effect.

A survey was conducted in Anuradhapura district during February and March using a questionnaire to identify the problems associated with BPH out break that occurred from December 1997 to January 1998. In addition, the fields were observed for plant density, the soil type and drainage problems. Two to three farmers whose fields had been severely damaged were randomly selected from each unit area or Agriculture Instructor (AI) range with the help of the extension officers. There are 32 unit areas in the Mahaweli System 'H' and 21 AI ranges in the Anuradhapura provincial and interprovincial areas. AI ranges or unit areas with low BPH infestation were not selected for the survey. Similarly, 1-2 farmers whose fields had not been infested were also selected from the same vicinity. Total number of farmers interviewed in this manner was 144. Records were made on the insecticides and fertilizer application, time of planting and seed rate. Impact of insecticide application at the vegetative phase on BPH damage was studied by comparing severely damaged rice fields with undamaged fields after separating them based on whether those fields had received insecticides at the vegetative phase or not. Similarly, impact of monitoring natural enemies, nitrogen fertilizer application, basal fertilizer application, application of organic manure, soil type, drainage and planting date on BPH damage were studied by comparing relevant sets of data. Chi Square Test was used to analyze the results.

Fifty one fields which received insecticides at the vegetative phase had been severely damaged whereas 24 fields with no insecticide application at any stage had escaped the BPH damage (Table 1). Of the 41 fields with no BPH damage, 25 had been monitored for natural enemies of rice pests while all the 103 fields which had severely been damaged had not been monitored for natural enemies (Table 1). These results show that indiscriminate use of insecticides which leads to the destruction of natural enemies is an important cause for BPH damage. The resurgence of brown planthopper due to insecticide application in the early stages of the rice crop is caused as a result of increased mortality of natural enemies (Banerjee 1996).

Of the 48 fields with severe BPH damage 36 received high rates of nitrogen fertilizer, higher than the recommanded rates whereas of the 29 fields with no BPH damage 21 received low rates of nitrogen fertilizer, lower than the recommended rate (Table 1). This is a clear indication that application of higher nitrogen dosages has a significant impact on BPH damage. Recommended rate of nitrogen fertilizer for a hectare of rice land is 225 - 275 kg of urea per hectare (Anon 1996). Fields where nitrogen fertilizer application was reported to be low had received urea at a range between 75 - 224 kg/ha. Dharmasena (1998) reported that the application of excess amount of nitrogen fertilizer is a major contributory factor for spreading chilli leaf curl complex caused by *Scirtothrips dorsalis* Hood. All the 103 fields with severe BPH damage had not received organic fertilizer. However, of the 41 fields which had escaped BPH damage, 13 had received organic manure. These results shows that application of organic manure suppresses BPH infestation.

Table 1. Effects of insecticide and fertilizer application, soil type, drainage planting date and seed rate on Brown Plant Hopper out-break in rice in 1997/98; SOuth-East monsoon seasonin the Anuradhapura District.

Factor	Function	No. of paddy fields: Severely damaged by BPH	No BPH damage	Chi square value
Insecticides	Applied[1]	51 (41.2)	14 (23.8)	16.8**
	Not applied[2]	15 (24.8)	24 (14.2)	
Monitoring of natural enemies	Monitored	0 (17.9)	25 (7.1)	76.4**
	Not monitored	103 (85.1)	16 (33.9)	
N. feat. application	Low[3]	12 (20.6)	21 (12.4)	16.8**
	High[4]	36 (27.4)	8 (16.6)	
Organic manure	Applied	0 (9.3)	13 (3.7)	44.1**
	Not applied	103 (93.7)	28 (37.3)	
Basal application	Applied	55 (57.5)	28 (23.5)	2.51[ns]
	Not applied	48 (45.5)	13 (17.5)	
Soil type	RBE[5]	35 (33.1)	6 (7.9)	1.1[ns]
	LHG[6]	57 (58.9)	16 (14.1)	
Drainage	Well Drainage	65 (61.2)	30 (26.8)	1.62[ns]
	Ill Drainage	22 (25.8)	7 (10.2)	
Planting date	Before 20.11.97[7]	76 (74.9)	13 (24.1)	18.0**
	After 20.07.97	27 (28.1)	28 (16.9)	
Seed rate	Recommended[8]	15 (18.9)	13 (9.1)	3.41†
	54 (50.1)	20 (23.9)		

Figures in parenthesis are expected values [1]Applied in the vegetative phase, [2]Not applied at any stage, [3]Lower than the recommended rate of 255 to 275 kg ha^{-1}. Lower range varies from 0 to 224, [4]Higher than the recommended rate mentioned in 3 above ranged from 276 to 600 kg ha^{-1}, [5]Reddish Brown Earth, [6]Low Humid Gley Soil, [7]Planting dates change from first week of October to fourth week of December. **Significant at p=0.1, †Significant at p=0.1, [ns]Not significant. [8]Recommended rate for round grain seed for broad casting is 75 kg ha^{-1}. The seed rate

Kajumura et al. (1995) reported that the population density of plant hoppers in organically fertilized fields are lower than those of chemically fertilized fields. Present study shows that basal fertilizer application, soil type and drainage had no significant impact on BPH infestation in 1997/98 South-West monsoon season in the Anuradhapura district (Table 1). Rice crop planted before November 20th (74) had severely been damaged whereas of the 41 fields with no BPH damage 28 had been planted after November 20th in the year 1997. This shows that early planted crop had been damaged by BPH over the late planted crop.

Minimum temperature had been around 23°C from the seventh week after October first in the year 1997 (i.e. after mid November) to nineteenth week (i.e. up to the last week of February) and it had been three to four degrees higher than that of the same periods of the previous two years (Fig 1). The maximum temperature during the same period from mid November to the last week of December in 1997 had been around 30°C and is also four degrees higher than that of the same period of the previous South-West Monsoon seasons. Therefore, the average temperature during the 1997/98 South-West monsoon seasons had been around 27°C whereas during the previous South-west monsoon seasons it had been well below 25°C. Heong *et al.* (1995) reported that oviposition of BPH is high when the temperature is between 25 - 30°C. This indicates that the temperature in the Anuradhapura District had been favourable for rapid proliferation of BPH. Cheng *et al.* (1992) reported that temperature was one of the key factors affecting population development of *Nilaparvata lugens*.

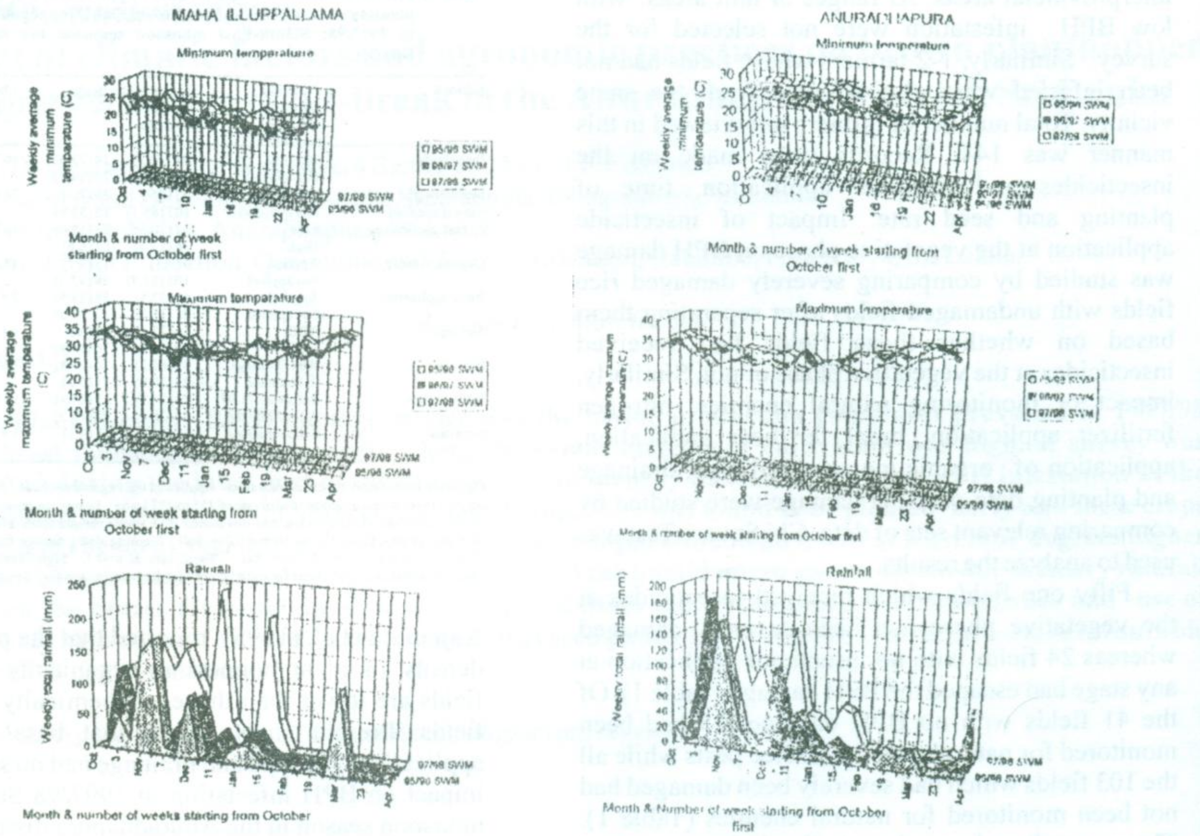

Fig. 1. Minimum and maximum weekly average temperatures and weekly total rainfall prevailed during three consecutive South-west Monsoon (SWM) seasons at Maha Illuppallama and Anuradhapura (1995-98).

The total rainfall prevailed from mid November to mid December at Maha Illuppallama had been in a range of 50 - 150 mm whereas it had been in a range of 0 - 60 mm during the same period in 1995 and 1996 (Fig 1). Although the trend at Anuradhapura is almost the same during the above mentioned period there had been a peak rainfall amounting to 200 mm from late December to early January at Maha Illuppallama. However, the rainfall at Anuradhapura from mid December to mid January in the 1997/98 SWM season had been higher than the previous SWM seasons. Such a high rainfall prevailed since late November to early January had been the cause to have a continuous supply of standing water in the paddy fields in the region resulting in high relative humidity in the micro-environment under the canopy of the rice plants. Therefore, it is clear that the ideal temperature together with high relative humidity under the canopy of the rice plant created by heavy rainfall are the major causes to trigger BPH infestation in 1997/98 South-West monsoon season. High temperature together with the high rainfall that prevailed in the season are consequences of *El-Nino* effect. Sudden drop of rainfall since early January, 1998 and farmer awareness programme conducted by the Department of Agriculture have contributed to escape BPH damage in rice crop planted after November 20th, 1997.

Results showed that 54 fields which were seeded at high rates had significantly ($p = 0.1$) higher degree of damage whereas 13 fields which received the recommended rate of seed paddy had escaped the BPH damage.

Then it can be concluded that comparatively high temperature (26 - 27°C) and high rainfall that prevailed almost continuously from December up to mid January are the main causes that triggered the BPH infestation in 1997/98 South-West monsoon season. Indiscriminate use of insecticides and use of excess amount of nitrogen fertilizer and seed paddy are additional factors conducive for rapid proliferation of BPH.

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