Population Dynamics of the Brown Planthopper *Nilaparvata lugens* (Stål) in Rice Fields in Thailand and Its Potential Applications to Pest Management

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ABSTRACT

The brown planthopper (BPH), *Nilaparvata lugens* (Stål) is an important pest of rice in temperate, sub-tropical and tropical regions of Asia. In Thailand, BPH outbreaks have reduced rice production and have been frequent in recent years. The present study examined the population dynamics of BPH and its natural enemies in rice fields in Central Thailand by field works for 3 years and clarified that no consistent differences were found in the population dynamics of *N. lugens* (Table 1) and the growth pattern of BPH between rice fields planted with BPH-resistant and susceptible varieties and that the typical seasonal growth pattern of BPH tropical populations was found only at one occasion. In addition, it is also indicated that the natural enemies of BPH, *Pardosa pseudoannulata* (Bösenberg & Strand), the wolf spider and *Cyrtorhynus lividipennis* (Reuter), the mirid bug, responded differently to increasing densities of BPH in

Table 1. Mean density of BPH and each of its natural enemies in fields planted with resistant and susceptible rice varieties

Site and Season	Rice Variety	Mean density over the crop season ((individuals/hill)±SE**)				
		BPH			Natural enemies	
		Nymphs	BPH-SW*	BPH-LW*	Mirid bug	Wolf spider
CH Dry	Res	0.17±0.07	0.04±0.01	0.07±0.02 **A**	0.12±0.04 **A**	0.43±0.22
	Sus	0.50±0.24	0.05±0.02	0.25±0.06 **B**	0.43±0.13 **B**	0.47±0.16
CH Wet	Res	0.34±0.08	0.08±0.02	0.30±0.03	0.30±0.14	0.62±0.28
	Sus	0.44±0.09	0.07±0.02	0.38±0.11	0.30±0.13	0.51±0.23
NN Wet	Res	0.37±0.06	0.05±0.01 **A**	0.32±0.07	0.21±0.09	0.44±0.19
	Sus	0.79±0.24	0.36±0.11 **B**	0.48±0.07	0.23±0.09	0.42±0.17

Means in a column with different letters are significantly different according Fisher's LSD post-hoc test ($p<0.05$*)

**Data are reported as the mean ± standard error

BPH-SW: short winged adults; **BPH-LW**: long winged adults

CH: Chai Nat Province; **NN**: Nakhon Nayok Province

Res: Resistant rice variety; **Sus**: Susceptible rice variety

Mirid bug: *C.lividipennis;* Wolf spider: *P.pseudoannulata*

different crop seasons and different rice fields (Table 2). Based on the results of this study, a simulation model to estimate population densities of BPH was developed. With this model and the aid of mapping techniques, the effect of climate and crop management practices such as varietal use and transplanting time on the building-up of BPH populations were visualized. The potential effects of pesticide use on the dynamics of BPH in resistant and susceptible genotypes were also analyzed. This study suggests

Table 3. Correlation matrix between mean densities of BPH and mean densities of its natural enemies in fields planted with resistant and susceptible rice varieties

Site	**Rice Variety**		*C. lividipennis* (MB)	*P. pseudoannulatta* (WS)
Chai Nat / Dry Season	Resistant	BPH - Nymphs	-0.37	-0.23
		BPH - Brachypterous	-0.19	-0.08
		BPH - Macropterous	*0.99	*0.93
	Susceptible	BPH - Nymphs	0.61	0.56
		BPH - Brachypterous	0.11	0.11
		BPH - Macropterous	*0.78	*0.79
Chai Nat / Wet Season	Resistant	BPH - Nymphs	0.36	0.05
		BPH - Brachypterous	0.10	-0.17
		BPH - Macropterous	-0.12	-0.09
	Susceptible	BPH - Nymphs	-0.73	0.46
		BPH - Brachypterous	-0.74	0.48
		BPH - Macropterous	0.78	-0.54
Nakhon Nayok / Wet Season	Resistant	BPH - Nymphs	*0.99	-0.82
		BPH - Brachypterous	0.85	*-0.96
		BPH - Macropterous	0.28	-0.07
	Susceptible	BPH - Nymphs	0.38	-0.42
		BPH - Brachypterous	-0.21	0.33
		BPH - Macropterous	0.49	0.28

*Pearson's correlation analysis significant at $p < 0.05$

that pest low-density conditions and the crop seasons have an effect on the population dynamics of BPH and its natural enemies and therefore, on the pest natural control by predators and the level of pest suppression in fields planted with BPH-resistant varieties. Furthermore, by the results from the described analyses, the importance of withholding the use of pesticides particularly in susceptible rice varieties, where the effects of management practices like variation in the time of the transplanting are suggested and the effect of climate seem to be enhanced on pesticide applied fields when compared to non-sprayed fields. Spatial distribution of risky areas and seasonal distribution of risky period are also indicated. The results of this study agree the research suggesting that in order to control effectively BPH populations, other factors than improving the resistance of the rice host may be more relevant. Furthermore, the general outcomes of this research showed a clear example on how field ecological studies can be applied on the development and improvement of past and new simulation models that describe the population dynamics of BPH. These outcomes can be used for the development of applications for the management of BPH in Thailand, where policy makers and researchers can be provided with essential information to develop recommendations to individual growers. The possibility for the application of the model to larger scales, where recommended managements may be encouraged on a regional scale, is also possible if the model is adapted to a particular area.