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EFFECT OF CROP GROWTH STAGES ON THE FIELD POPULATION OF RICE HOPPERS

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ABSTRACT

The rice hoppers viz., brown plant hopper (BPH) *Nilaparvata lugens* (Stal), white-backed planthopper (WBPH) *Sogatella furcifera* (Horvath) and green leafhopper (GLH) *Nephotettix virescens* Distant cause loss in rice and the damage is influenced by plant growth stages. Field experiment has been conducted in this study to evaluate the effect of the growing stages on the incidence of these hoppers at the Agricultural Research Farm, Banaras Hindu University, Varanasi, Uttar Pradesh, India during kharif 2018 and 2019. The results revealed that the incidence is significantly varying among the growth stages, and positively correlated ($p < 0.05$). *Nilaparvata lugens* and *S. furcifera* are the most abundant during the maximum tillering to booting stage. In contrast that of *N. virescens* peaked during the booting to flowering stage.

Key words: Rice, *Nilaparvata lugens, Sogatella furcifera, Nephotettix virescens*, incidence, crop phenology, seedling, tillering, booting, flowering, ripening, population dynamics

Rice (*Oryza sativa* L.) is a crop belonging to the family Poaceae and is an internationally vital cereal crop and staple food (Sharma et al., 2018a; Ali et al., 2019). In the rice ecosystem, more than 250 insect pests and 350 beneficial arthropods had been reported from various agroecological zones (Ali et al., 2020). In 2018, around 20 insects were considered significant for the economic damage to the production of rice in India (Sharma et al., 2018b; 2019). Rice hoppers mainly brown planthopper (BPH) *Nilaparvata lugens* (Stl), white-backed planthoppers (WBPH), *Sogatella furcifera* (Horvath) and green leafhoppers (GLH), *Nephotettix virescens* Distant, are major rice pests that have severely harmed rice production in Asia (Sharma et al., 2019; Zhu et al., 2020). These rice hoppers cause direct damage to rice crops by sucking sap and plugging xylem and phloem with their sheaths during feeding period (Sharma et al., 2018c; Ma et al., 2021). Continued feeding of insects causes a drying process that results in "hopper burns". Planthoppers are vectors for viruses such as rice tungro, grassy stunt, and ragging stunt, as well as causing significant physiological damage to rice (Azgar and Yonzone, 2018). The insect pests' relationship with their host is an important factor in determining whether the insect develops and reproduces, as well as whether the populations grow (Awmack and Leather, 2002). Conversely, the plant's susceptibility to insect attacks is determined by its chemical constituents and morphological characteristics (Faruq et al., 2018). Thus, the selection of a stage-specific pest management strategy is an important step in pest management because the interactions between pest and host factors determine the level of infestation and crop stage of the species. The objectives of this paper were to examine the effect of crop growth stages on the population of rice hoppers during two consecutive kharif seasons during 2018 and 2019.

MATERIALS AND METHODS

The field experiment was carried out during kharif 2018 and 2019, at the Agricultural Research Farm, Banaras Hindu University, Varanasi, Uttar Pradesh, India (24°56'N,82°14' E, 82 masl). Variety (cv. Swarna sub-1) procured from the Agricultural Research Farm of the University and was sown in nursery beds on July 5th, 2018 and July 9th, 2019. Twenty-one day old seedlings were transplanted @ 2-3 seedlings/ hill on a plot size of 200 m^2. All the recommended agronomic practices were followed, and no insecticide was applied. The number of motile (adult and nymph) stages of BPH and WBPH was counted on five hills chosen at random in the experimental plot. Each hill was tilted twice or three times on the base to count the number of BPH and WBPH individuals as well as the hoppers that fell into the water. The GLH adults (male and female) were collected through sweep net with the sampling size of 5 sweeps/ replication at weekly intervals from 28-47 standard meteorological weeks (SMW). Tukey test ($p < 0.05$) was used to compare the abundance of hoppers with the crop growth stages (seedling, tilling, booting, flowering and maturing). The software IBM SPSS version 24.0 for Windows (IBM Corporation, Armonk, New York, USA) was used to perform the Tukey test.

RESULTS AND DISCUSSION

The phenological stages of rice plant significantly affected the *N. lugens* incidence; nymphs and adults were found active during the tillering to ripening stage (Table 1); pooled data revealed that their counts differed significantly with the growing stages ($F = 54.02$, df = 4, 15, $p < 0.05$). The booting stage (17.47± 2.22/ hill) of the crop was the most preferred, followed by the flowering (13.77± 1.54/ hill) and the tillering stages (8.76± 1.39/ hill); and nil during the seedling stage, while the peak was in the late tillering to flowering stage. The present findings agree with those of Hafizal and Idris (2013), who observed peaks during the vegetative stages. In contrast Skawsang et al. (2019) observed increase of incidence in the reproductive stage with a peak in early maturing stage. Faruq et al. (2018) observed its slightly higher abundance during the maximum tillering stage; its incidence increase during rice crop growth and then decline during preharvest phases when senescence begins to cause changes in nutrition, chemicals, and structures (Xu et al., 2013).

The incidence of *S. furcifera* was active during the late tillering to ripening stages, the pooled data revealed that it differed significantly with growing stages ($F = 65.16$, $df = 4, 15$, $p<0.05$), with booting stage showing maximum incidence (22.91± 2.71/ hill), followed by the tillering stage (15.42± 1.89/ hill); however, with the ripening stage it became less (7.12± 0.95/ hill), while it was nil in the seedling stage. Plant phenology exhibited a significant influence on the density of *S. furcifera*- its incidence increased in the vegetative stage and then declined as the harvest neared (Hafizal and Idris, 2013); the booting stage revealed maximum incidence followed by the maximum tillering and flowering stages (early maturing stage). The present results agree with those of Skawsang et al. (2019), Mangalgikar and Harsur (2012) and Xu et al., 2013). With *N. virescens* (nymph and adult), maximum counts/ hill was during the booting stage (10.33± 1.50/ hill) followed by the tillering stage (25.94± 2.08/ hill), with least counts in in the ripening stage (1.58± 0.07/ hill), nil in the seedling stage, and the peak observed in the late tillering to flowering stage. These findings agree with those of Zhong-xian et al. (2006). According to Xu et al. (2013), food availability increases during rice growth, and the population and density of leafhoppers peak during the booting stage. Similar observations were made by Hafizal and Idris (2013). In contrast, Faruq et al. (2018) observed maximum incidence during the seedling to early tillering stage. Thus, the crop growth stages had a significant impact on the incidence of rice hoppers.

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AUTHOR CONTRIBUTION STATEMENT

KRS: Conceptualization, Methodology, Investigation, Writing - original draft. SVSR: Supervision, Data curation, Writing - review & editing, Writing - original draft. SRB: Writing - review and editing. KS: Analyzed data.

CONFLICT OF INTEREST

No conflict of interest.

Table 1. Incidence of rice hoppers vs phenology of rice crop (pooled data, kharif 2018, 2019)

Phenological stage	Incidence (no./ hill)		
	Nilaparvata lugens	*Sogatella furcifera*	*Nephotettix virescens*
Seedling	0.00 ± 0.00^{d}	0.00 ± 0.00^{d}	0.00 ± 0.00^{c}
Tillering	8.76 ± 1.39^{c}	11.36 ± 1.64^{c}	5.59 ± 0.72^{b}
Booting	17.47 ± 2.22^{a}	22.91 ± 2.71^{a}	10.33 ± 1.50^{a}
Flowering	13.77 ± 1.54^{ab}	15.42 ± 1.89^{b}	7.67 ± 1.07^{b}
Ripening	5.05 ± 0.64^{c}	7.12 ± 0.95^{c}	1.58 ± 0.07^{c}
$F_{(4/15)}$	54.02	48.46	32.64

Mean (± SE) followed by the same alphabets in columns were not statistically different by the Tukey test ($p < 0.05$)

REFERENCES

Ali M P, Bari M N, Haque S S, Kabir M M, Afrin S, Nowrin F, Islam M S, Landis D A. 2019. Establishing next-generation pest control services in rice fields: eco-agriculture. Scientific Reports 9 (1): 1-9.

Ali M P, Kabir M M M, Haque S S, Afrin S, Ahmed N, Pittendrigh B, Qin X. 2020. Surrounding landscape influences the abundance of insect predators in rice field. BMC Zoology 5(1): 1-12.

Awmack C S, Leather S R. 2002. Host plant quality and fecundity in herbivorous insects. Annual Review of Entomology 47 (1): 817-44.

Azgar A, Yonzone R. 2018. Studies on the transmission and virus-vector relationship of rice-tungro virus (rtv) in different rice genotype. The Bioscane 13 (2): 607-611.

Faruq M O, Khan M M, Rahman M A, Ullah M H. 2018. Rice growth stages and temperature affect the abundance of leafhoppers and plant hoppers. SAARC Journal of Agriculture 16 (1): 95-104.

Hafizal M M, Idris A B. 2013. Field population abundance of leafhopper (Homoptera: Cicadelidae) and planthopper (Homoptera: Delphacidae) as affected by rice growth stages. In AIP Conference Proceedings 1571 (1): 359-362.

Ma W, Xu L, Hua H, Chen M, Guo M, He K, Zhao J, Li F. 2021. Chromosomal-level genomes of three rice planthoppers provide new insights into sex chromosome evolution. Molecular Ecology Resources 21 (1): 226-237.

Mangalgikar P, Harsur M. 2012. Incidence of Brown Planthopper (BPH) *Nilaparvata lugens* Stal. (Delphacidae: Hemiptera) in relation to age of the Rice Crop. International Journal of Agriculture Science 3 (3): 197-200.

Sharma K R, Raju S V S. 2019. Field Efficacy of some Combination Insecticide Formulations against Paddy Planthoppers. Pesticide Research Journal 31 (1): 119-125.

Sharma K R, Raju S V S, Jaiswal D K. 2018c. Influence of environmental effect on the population dynamics of brown plant hopper, *Nilaparvata lugens* (Stal) and White-Backed plant hopper, *Sogatella furcifera* (Hovarth) in Varanasi region. Journal of Entomological Research 42 (3): 339-342.

Sharma K R, Raju S V S, Jaiswal D K, Roshan D R. 2019. Effects of environmental factors on population dynamics of rice earhead bug and their management with newer insecticide combinations and sole insecticide. Bangladesh Journal of Botany 48 (4): 973-979.

Sharma K R, Raju S V S, Jaiswal D K, Singh P. 2018a. Efficacy of certain newer insecticide formulations against yellow stem borer, *Scirpophaga incertulas* (Walker) infesting on rice crop. Journal of Experimental Zoology India 21 (2): 771-775.

Sharma K R, Raju S V S, Roshan D R, Jaiswal D K. 2018b. Effect of abiotic factors on yellow stem borer, *Scirpophaga incertulas* (Walker) and rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) population. Journal of Experimental Zoology. India 21 (1): 233-236.

Skawsang S, Nagai M, K Tripathi N, Soni P. 2019. Predicting rice pest population occurrence with satellite-derived crop phenology, ground meteorological observation, and machine learning: a case study for the Central Plain of Thailand. Applied Sciences 4 (22): 4846.

Xu S, Wang H, Wang E, Zhao G.2013. Reproductive rate of rice brown planthopper population of super rice Yongyou 6. Advance Journal of Food Science and Technology 5 (5): 539-542.

Zhong-Xian L, Villareal S, Xiao-ping Y U, Heong K L, Cui H U. 2006. Biodiversity and dynamics of planthoppers and their natural enemies in rice fields with different nitrogen regimes. Rice Science 13 (3): 218-226.

Zhu J, Zhu K, Li L, Li Z, Qin W, Park Y, He Y. 2020. Proteomics of the honeydew from the Brown Planthopper and green Rice leafhopper reveal they are rich in proteins from insects, Rice Plant and bacteria. Insects 11 (9): 582.

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