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Impact of climate change on brown plant hopper, *Nilaparvata lugens* (Stal) incidence and management in rice eco system in Srikakulam district of Andhra Pradesh

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Abstract
Rice is a major cultivated (2.05 lakh ha) crop in Srikakulam district of Andhra Pradesh during *kharif* season. However, rice productivity in the district was on the lower side due to many abiotic and biotic constraints. Of many biotic factors, brown plant hopper (BPH), *Nilaparvata lugens* (Stal.) is one of the most important sucking pests of rice, which is causing huge crop losses during certain years. The peak incidence of this pest was observed during August to October months due to continuous dry spell during these months. The recorded highest temperature during this period was 32.0-34.3 ^{0}C, whereas, the lowest temperature recorded was 31.9 – 32.5 ^{0}C. Present study revealed that, the increase in temperature resulted in higher pest incidence during the active tillering stage (26-28 insects/hill) and PI stage (30-32 insects/hill). Integrated pest management in rice resulted in low pest incidence (7-8 insects/hill) compared to the non IPM fields (15-18 insects/hill). There was as average of 9.57% yield increase was also observed.

Keywords: Rice, brown plant hopper, *Nilaparvata lugens*, climate change

Introduction
Rice (*Oryza sativa* L.), the world's most important staple food which provides nutrition to majority of the world's population. In India, rice is grown on an area of 43.94 million ha with a production of 106.65 million tons [1]. Rice is growing in 2.05 lakh ha during *Kharif*season in Srikakulam district of Andhra Pradesh state. However, rice productivity in the district was on the lower side due to many abiotic and biotic constraints. Of many biotic factors, the Brown Plant Hopper (BPH), *Nilaparvata lugens* (Stål) (Hemiptera: Delphacidae) is one of the most serious pests of rice in both temperate and tropical regions of rice growing areas and has reached outbreak levels over the past few years [2]. This pest directly damages the plant by sucking phloem sap, which in turncausing hopper burn, and also sometimes by transmitting viral diseases [3]. BPH, resulting in losses valued at US $120 million [4]. Widespread outbreaks of brown planthopper during the rice crop seasons, causing heavy yield losses were observed in recent years. The global climate change is a reality in the present context and the adverse changes in climate has a positive impact on insect population, particularly in phloem sucking insect like BPH. The previous studies are also indicating that there was increase in the global temperature and CO_2 elevations [5] which resulted in increase in BPH population [6, 7]. Even the pest population and the damage levels were at increasing rate in Srikakulam district of Andhra Pradesh, where the presents study was conducted on incidence of BPH and its management.

Materials and Methods
Srikakulam district is located in north coastal region of Andhra Pradesh state at MSL of 30.7, prevailing with warm humid climatic condition. The annual rainfall is 1100mm with max. temperature range 34-38 ^{0}C and minimum temperature range 20-25 ^{0}C. Present investigation was carried out during *Kharif*, 2015-18 to study the effect of weather parameters on infestation of Brown Plant Hopper under normal conditions in the paddy eco system. Generally, paddy sowing starts from 2nd FN of June and transplanting will continue upto 2nd FN of August. The most cultivating rice varieties are BPT 5204 and MTU 7029. A total number of 50 samples were collected from five different locations which consists of two plats form each location at fortnight intervals.

The meteorological data on rainfall, temperature, relative humidity was collected from Agro Meteorological Unit of Agricultural Research Station, Amadalavalasa for *Kharif* season. To find out the relation between population of BPH and abiotic factors correlation and regression tests were administered.

Integrated pest management module was also demonstrated at farmers' fields in different locations of Srikakulam district. Creation of 20 cm Alleyways at 2m distance, optimized Nitrozen application, alternate wetting and drying, need based chemicals were demonstrated along with farmers practice as check. BPH Population was collected from the selected fields from both IPM and farmers plots and analyzed.

Results and Discussion

Results indicated that, the BPH population was observed during the maximum tillering to grain development stage (September to November month) of rice crop during Kharif 2015-2018. The peak incidence of BPH was observed during 2nd FN of September to 2nd FN of October (Fig.1). These results are in confirmation with the earlier studies. It was observed that peak incidence of BPH was observed during 2nd week of August to 2nd week of November [7, 8] September – October [9]. In this study, the hopper population was decreased during 2nd FN of November to December as the crop has come to maturity. Chaudhary *et al*. (2014) also reported that, pest population was at decreasing rate during November to December.

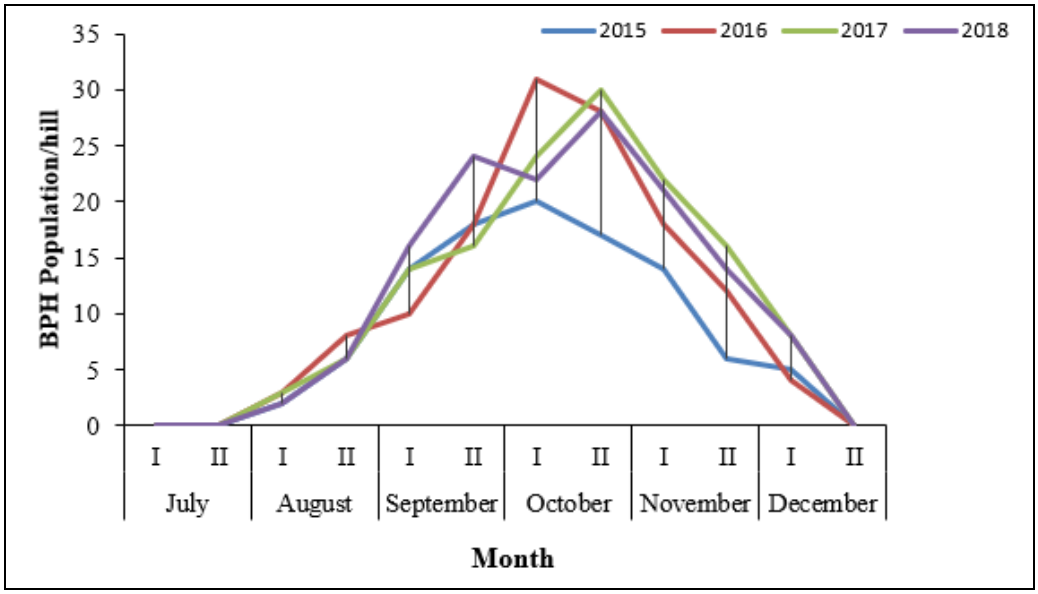

Fig 1: BPH Population recorded during July – December, 2015-2018

Correlation studies of BPH with weather parameters

The present study also revealed that, BPH population was in significant positive correlation with maximum temperature (0.929) and morning relative humidity (0.918) during 2015-2018. It is also evident from the table 2 that, the BPH population was also in positive correlation with rainfall (0.50) and evening relative humidity (0.40). Whereas, the BPH population was in negative correlation with minimum temperature (-0.741). Similar findings were reported by Sarkar *et al*. (2018) who found that the BPH population was significantly influenced by the weather parameters especially temperature and relative humidity. Chaudhary *et al*. (2014) reported the similar findings, temperature was positively correlated with BPH population. Krishnaiah *et al*. (2006) also reported a positive correlation of BPH population with temperature.

Table 1: Mean BPH population and weather parameters recorded during *Kharif* 2015-2018

Year	Average No of BPH/ Hill	Max. Temp (^{0}C)	Min. Temp (^{0}C)	Morning R.H	Evening R.H.	Rainfall
2015	8.25±2.1	30.03	24.69	88.00	63.30	2.53
2016	11.08±2.93	32.30	23.00	87.61	62.82	3.48
2017	11.33±3.05	32.37	24.07	88.48	66.38	3.70
2018	12.17±3.15	32.18	22.61	86.91	63.65	4.07

Table 2: Correlation between BPH population and weather parameters during *Kharif*, 2015-2018

	Variable	Correlation Coefficient (r)
X_1	Max. Temp (^{0}C)	0.929
X_2	Min. Temp (^{0}C)	-0.741
X_3	Morning R.H	0.918
X_4	Evening R.H.	0.403
X_5	Rainfall	0.504

In the present study, indicated that due to increase in atmospheric temperature results in increase of BPH population during 2015-2018. The temperature trend was at increase in rate during the years, which resulted in increase in BPH population in rice eco system, resulted in higher damage to rice crop. Pandi *et al*. (2018) also reported that, the increase in temperature has significant positive effect on BPH multiplication and its population. It was also evident that, the relative humidity also influencing the pest population. The increase in morning relative humidity in the micro climate of rice eco system, favours the buildup of pest population and continuously increased in the later stages of crop. The life cycle may be decreased and number of generations may be increased with rapid changes in the climate. Auad *et al*. (2012) also observed that every degree rise in temperature, the

life cycle of insect would be shorter. The shorter life cycle of insect leads to higher population of pest.

Integrated pest management of BPH

Results indicated that the BPH population was comparatively less in IPM followed plots compared to Farmers practice plots (Non IPM). The mean BPH population was 8.2, 8.8, 6.8 and 6.4 in the IPM plots during 2015, 2016, 2017 and 2018 respectively. Whereas, the BPH population was ranged from 11.0 to 12.8 in farmers practice plots during *Kharif*, 2015 to 2018 (Table 3). There was significant decrease in BPH population in IPM followed plots compared to farmers practice. The present study revealed that the yield was improved in IPM followed plots compared to farmers practice. Yield range was 5975 to 6210 kg per ha in IPM followed plots, whereas, the yield range was 5480 to 5635 kg per ha in farmers practice. Yield increase per cent was 7.7 to 10.2 over the farmers practice. It is clearly evident that adopting IPM will decrease the BPH population in rice ecosystem which in turn can reduce the damage due to this pest and will increase the yield.

Table 3: BPH Population in IPM and Non IPM plots during *Kharif*, 2015-2018

Year	BPH Population/ Hill		Yield (Kg/Ha)		Yield increase (%)
	IPM	Farmers practice	IPM	Farmers practice	
2015	8.2±2.0	12.0±2.82	5975	5540	9.66
2016	8.8±2.13	11.2±2.33	5840	5480	9.62
2017	6.8±1.77	12.8±3.33	6210	5635	10.20
2018	6.4±1.28	11.0±2.70	6080	5585	8.86

The reasons for high incidence of BPH population may be due to non-adoption of alleyways and close plating in the farmers practice plots. In addition, indiscriminative use of Nitrogen fertilizer application may be another reason for high incidence of BPH population. Earlier research also confirming that, high fertilizer rates are favorable to the development of BPH populations [10]. BPH survival rate is enhanced with N supplementation to rice plants as reported earlier [11, 12]. Due to these reasons, there was more population of BPH compared to IPM plots. Alleyways at 2m in the transplanted rice will help in decrease the BPH population. Krishnayya (2014) also reported that, alleyways in rice fields tend to inhibit multiplication of BPH and WBPH due to aeration in the rice ecosystem.

Conclusions

Climate change has as adverse effect not only on growth of the plant but also it is causing high outbreak of pest and diseases. This study also revealed that, the temperature increase due to climate change has significant and positive effect on BPH incidence in paddy. To optimize the BPH populations due to climatic changes in the environment and to decrease the damage due to this pest, adoption of recommended IPM practices is the positive solution in the tropical climate like Srikakulam district.

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References

1. INDIASTAT 2014 Rice production statistics. http://www.indiastat.com/table/agriculture/2/rice/17194/56320/ data.aspx. Online database Accessed 1 March, 2020.
2. Hu G, Cheng XN, Qi GJ, Wang FY, Lu F. Rice planting systems, global warming and outbreaks of *Nilaparvata lugens* (Stål). Bulletin of Entomological Research. 2011; 101:187-199
3. Rivera CT, Ou SH, Lida TT. Grassy stunt disease of rice and its transmission by *Nilaparvata lugens* (Stal). Plant Disease Report. 1966; 50:453-456.
4. Du PV, Cabunagan RC, Cabauatan PQ, Choi HS, Choi IR. Yellowing syndrome of rice: etiology, current status and future challenges. Omonrice. 2007; 15:94-101
5. IPCC, Observed changes in climate and their effects. In Climate Change. Synthesis Report (ed. Pachauri, P. K. and Reisinger, A.), Cambridge University Press, UK, 2007, 8-15
6. Pandi GGP, Subhash Chander, Madan Pal Singh, Himanshu Pathak. Impact of Elevated CO2 and Temperature on Brown Planthopper Population in Rice Ecosystem. Proceedings of National Academy of Sciences, India Section B. Biological Sciences. 2018; 88(1):57-64.
7. Sunil Vailla, Sampathkumar Muthusamy, Chiranjeevi Konijeti, Chitra Shanker, Jhansi Lakshmi Vattikuti. Effects of elevated carbon dioxide and temperature on rice brown planthopper, *Nilaparvata lugens* (Stål) populations in India. Current Science. 2019; 116(6):988-996.
8. Sachan SK, Singh DV, Chaudhary AS. Seasonal abundance of insect pests associated with basmati rice. Annals of Plant Protection Sciences. 2006; 14(1):247-248.
9. Sarkar DA, Baliarsingh, Mishra HP, Nanda A, Panigrahi G, Mohapatra AKB *et al*. Population dynamics of brown plant hopper of paddy and its correlation with weather parameters. International Journal of Chemical Studies. 2018; 6(6):920-923
10. Chaudhary S, Raghuraman M, Kumar H. Seasonal abundance of brown plant hopper *Nilaparvata lugens* in Varanasi region India. International Journal of Current Microbiology and Applied Sciences. 2014; 3(7):1014-1017.
11. Dyck VA, Misra BC, Alam S, Chen CN, Hsieh CY, Rejesus RS. Ecology of the brown plant hopper in the tropics. Brown planthopper: threat to rice production in Asia. Los Baños, Philippines. 1979; 61-98
12. Preap V, Zalucki MP, Nesbitt HJ, Jahn GC. Effect of fertilizer, pesticide treatment and plant variety on realized fecundity and survival rates of *Nilaparvata lugens* (Stål); generating outbreak in Cambodia. Journal of Asia-Pacific Entomology. 2001; 4:75-84
13. Lu ZX, Heong KL, Yu XP, Hu C. Effects of plant nitrogen on ecological fitness of the brown plant hopper, *Nilaparvata lugens* in rice. Journal of Asia-Pacific Entomology. 2004; 7:97-104
14. Krishnaiah NV, Prasad ASR, Rao CR, Pasalu IC, Zaheruddeen SM, Varma NRG. Population dynamics of rice brown plant hopper, *Nilaparvata lugens*in Godavari Delta of Andhra Pradesh State. Indian Journal of Plant Protection. 2006; 34(2):158-164.
15. Auad AM, Fonseca MG, Resende TT, Maddalena ISCP.

Effect of climate change on longevity and reproduction of *Sipha flava* (Hemiptera: Aphididae). The Florida Entomologist. 2012; 95(2):433-444.
16. Lu ZX, Heong KL. Effects of nitrogen-enriched rice plants on ecological fitness of planthoppers. In: Heong KL, Hardy B (eds) Planthoppers: New threats to the sustainability of intensive rice production systems in Asia. International Rice Research Institute, Los Baños, 2009, 247-256.
17. Krishnaiah NV. A Global Perspective of Rice Brown Plant hopper Management III - Strategies for BPH Management. Rice Genomics and Genetics. 2014; 5(1).