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Construction of stage specific life table of rice brown plant hopper (*Nilaparvata lugens* Stal.) on Pusa Basamati-1 and Pant Dhan-12 under natural condition

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Abstract
The present investigation was conducted on "Construction on of stage specific life table of Rice Brown Plant Hopper (*Nilaparvata lugens* Stal.) on Pusa Basmati-1 and Pant Dhan-12 under natural condition" in White Grub Project Research Laboratory, Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during *Kharif*, 2017. Life table studies, viz stage specific and survival of *N. lugens* Stal. on two different rice variety *i.e*. Pusa Basmati-1 and Pant Dhan-12 under natural condition indicate the insect preferred both the host species but Pusa Basmati-1 were favored and suitable food for the development of *N. lugens* Stal. stage specific life-table the apparent mortality at 5thinstar nymph stage were shows that highest value 27.59 percent on Pant Dhan-12 where as compared on Pusa Basmati-1 recorded 23.81 percent. The lowest apparent mortality 6.17 percent was recorded at 2nd instar nymph stage, on Pusa Basmati-1 whereas lowest 7.59 percent recorded on Pant Dhan-12. The highest survival fraction was recorded at 2nd instar nymph stage 0.94 and 0.92 Pusa Basmati-1 and Pant Dhan-12, while minimum survival fraction was recorded at 5th instar nymph stage 0.76 and 0.72 on Pusa Basmati-1 and Pant Dhan-12. The k-value is the key factor, which is primarily responsible for increase or decrease in number from one generation to another. The highest k-value 0.38 was observed on Pusa Basmati-1 and the lowest k-value 0.32 observed on Pant Dhan-12.

Keywords: *Nilaparvata lugens*, Stage specific, life table, natural condition

1. Introduction
Rice (*Oryza sativa* Linn.) is a very important cereal crop belongs to the family Poaceae. It is one of the world's largest cereal crops providing the caloric need for millions of people. The rice crop plays a vital role in our national food security and is a means of livelihood of rural households. It covers 11 percent of world cropped area and is cultivated in more than 214 countries globally with production of 502.2 million tonnes worldwide. Asian countries shared 90 percent and 684.2 million tonnes of world's rice production. India contributes 24 per cent of Asian countries rice production. India has the largest area under rice cultivation with 45 million ha. and also, second largest producer of rice in 2017 next to China [2]. The consumption of rice is associated with diabetes mellitus due to its high glycemic index. In other hand, some of rice components namely rice bran and rice bran oil contained some minor components which are reported to have some biological effects. Rice can be contaminated by some toxic elements such as arsenic and mercury coming from water and land in which it grows. Rice bran will produce rice bran oil and defatted rice bran. Defatted rice bran component consists a number of polysaccharide and dietary fibers that support in cancer and cardiovascular diet therapy. Such biological activities which are related to rice and its products are decreasing low density lipoprotein level, lowering cholesterol, reducing blood pressure and preventing colorectal cancer [5]. A life table developed from field data may be used to estimate fitness of a population as influenced by biotic and abiotic factors. On the other hand, life tables constructed using natural condition data are useful in revealing the maximal growth potential of a population. The objective of current work was to determine the type and rate of BPH mortality that occur at different life stages on different rice varieties and also to determine the key factors associated with such mortality [10].

2. Materials and Methods

2.1 Location of Study Area

The area under investigation is situated 29^0 04' N latitude and 77^0 42' E longitudes at an altitude of 237 meter above the mean sea level (MSL). The Meerut district of Western Uttar Pradesh has a total area of 2,522sq km. It is bounded by Muzaffarnagar, Bijnor, J.P. Nagar, Hapur, Ghaziabad, Baghpat, and Shamli district in North, South West, South, West, East and North East, respectively. Meerut has a total population of over 3.4 million. The Ganga and Hindan are adjoining major rivers of the district.

Data on stage specific survival for eggs, nymph and adults were recorded from the age specific survival and mortality life-table. The data obtained from each table were used for computing various life parameters as given below.

X = Age of the Insect in days.

Ix= Number surviving insects at the beginning of each interval x out of 100.

dx = Number dying during the age interval x out of 100.

100qx = Mortality rate at the age interval x.

2.2 Climate

Meerut has sub-tropical and semi-arid climate with hot and dry summers and cold winters. High rainfall and wide temperature range are the characteristic features of this region. Normally rain continues from July to September and few showers are also expected during the spring season. Cold generally occur towards the end of December and may continue till the end of January. The studies on several aspects related to *Nilaparvata lugens* Stal were conducted under natural condition in the White Grub Project Research Laboratory, Department of Entomology, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.).

2.3 Experimentation

All the experiments were conducted in White Grub Project Research Laboratory, Department of Entomology, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.)

2.4 Apparent Mortality: This is measured mortality and gives the information on number dying as percentage of number entering that stage and was calculated by using the formula. Apparent mortality = lx+1(X+1)/2

2.5 Stage Specific Survival Fraction (S_x): Data obtained on apparent mortality was used for the calculation of the stage specific survival fraction (S_x) of each stage by using equation.

S_x of particular stage = [lx of subsequent stage] / [lx of particulars stage]

2.6 Generation Survival Fraction (S_G): This parameter was calculated by the following equation.

$S_G = S_E . S_N$

Where, $S_E = S_X$ of egg stage

$S_N = S_X$ of nymphal stage.

2.7 Mortality Survival Ratio (M.S.R.): It is the increase in population that was occurred if the mortality in the stage, in question had not occurred and calculated as follows-

M.S.R. of particular stage = [l_x mortality in particular stage] / [l_x of subsequent stage]

2.8 Indispensable Mortality (IM): This type of mortality would not have occurred unless the factor (S) causing it was not allowed to operate, while the subsequent mortality factors operate. The equation is;

IM= Number of adults emerged x M.S.R. of particular stage.

2.9 K-values: It is the key factor which is primarily represented for increase or decrease in number from one generation to another and was computed as the difference between the successive values for "log l_x". The total generation mortality was calculated by adding the k-values of different development stages of the insect which is designated/Indicated as "K" [9, 10].

$K = k_0 + k_1 + k_2 + k_3$

Where k_o, k_1, k_2 and k_3 are the k-values at egg, nymphal stages, respectively.

The Procedures adopted for computations of various life parameters were as specified by [1, 9, 8, 7, 10, 4].

Fig 1: Rearing Cages used in the present study.

3. Results and Discussion

The stage specific life-table was evaluated from the data obtained from age specific life-tables. The parameters taken in this table comprised apparent mortality, stage specific survival fraction, generation survival fraction, mortality survival ratio, indispensable mortality and 'k' values.

3.1 Apparent mortality (100qx)

The data revealed that the highest apparent mortality of 12 percent at egg stage was on Pant Dhan-12 followed by 11 percent on Pusa Basmati -1 (table 1-2) and (Fig 2-3). As far as mortality at 1st instar nymph stage was concerned it was highest on Pant Dhan-12 (10.23 percent) and on Pusa Basmati -1 (8.99 percent). The apparent mortality at 2nd instar nymph produced maximum value of 7.59 percent on Pant Dhan-12 while it was 6.17 percent on Pusa Basmati-1. It was at 3rd instar nymph stage highest 14.10 percent on Pant Dhan-12 and lowest 12.35 percent on Pusa Basmati-1. It was at 4th instar nymph highest 13.43 percent on Pant Dhan-12 and lowest 11.27 on Pusa Basmati-1. At 5th instar nymph stage concerned it was highest 27.59 percent on Pant Dhan-12 and lowest 23.81 percent on Pusa Basmati-1.

3.2 Survival Fraction (Sx)

The data revealed (Table 1-2) that the highest survival fraction of 0.89 at egg stage was on Pusa Basmati -1 followed by 0.88 on Pant Dhan-12. As far as survival fraction at 1st instar, 2nd instar, 3rd instar, 4th instar and 5th instar nymph stage were concerned, it were 0.91, 0.94, 0.88, 0.89 and 0.76

on Pusa Basmati -1, followed by 0.90, 0.92, 0.86, 0.87 and 0.72 on Pant Dhan-12.

The generation survival fraction S_G was recorded,

Pusa Basmati-1 S_G = 0.89 (0.91 + 0.94) 0.88×0.89×0.76 = 0.980049

Pant Dhan-12 S_G = 0.88 (0.90 + 0.92) 0.86×0.87×0.72 = 0.862788

3.3 Mortality Survival Ratio (MSR)

The data revealed that the highest MSR of 0.14 at egg stage was on Pant Dhan-12 followed by 0.12 on Pusa Basmati -1(Table1-2). As far as MSR at 1st instar, 2nd instar, 3rd instar, 4th instar and 5th instar nymph stage were concerned, it were 0.11, 0.08, 0.16, 0.16 and 0.38 on Pant Dhan-12, followed by 0.10, 0.07, 0.14, 0.13 and 0.31 on Pusa Basmati -1.

3.4 Indispensable Mortality (IM)

At egg stage of *N. lugens* Stal. exhibited highest 5.93 of indispensable mortality was on Pusa Basmati-1 and lowest 5.73 on Pant Dhan-12. The value so obtained at 1st instar, 2nd instar, 3rd instar, 4th instar and 5th instar nymph stage were 4.74, 3.16, 6.76, 6.10 and 15.00 on Pusa Basmati-1 and 4.78, 3.04, 6.90, 6.52 and 16.00 on Pant Dhan-12, respectively. The minimum value of IM (0.00) was recorded at adult stage on both varieties.

3.5 k- value

The maximum k- value of 0.06 on Pant Dhan-1 and 0.05 on Pusa Basmati-12 were recorded at egg stage. However, the minimum (0.00) was encountered at adult stage on both rice varieties. Total generation mortality 'k' was also computed and it was interesting to note that both varieties *viz*., Pusa Basmati-1 and Pant Dhan-12, while it was 0.32 and 0.38 respectively.

The stage specific life-table with different development satge displayed change in generation survival of *Nilaparvata lugens* Stal. on Pusa Basmati-1 and Pant Dhan-12. The present observed data of stage specific life-table on both rice variety. The apparent mortality (100qx), survival fraction (Sx), Mortality survival ratio, Indispensable mortality and k- value are agreement with the finding of [10, 11]. The present study partially relationship with the finding of [3, 6]

Table 1: Stage specific life table of *Nilaparvata lugens* Stal. on Pusa Basmati –1

Stages (X)	No. of surviving at beginning of stage (lx)	No. of dying at stage (dx)	Apparent mortality (100qx)	Survival fraction (Sx)	Mortality/Survival ratio (MSR)	Indispensable mortality (IM)	log lx	k-values
Egg	100	11	11.00	0.89	0.12	5.93	2.00	0.05
Ist instar Nymph	89	8	8.99	0.91	0.10	4.74	1.95	0.04
IInd instar Nymph	81	5	6.17	0.94	0.07	3.16	1.91	0.03
IIIrd instar Nymph	81	10	12.35	0.88	0.14	6.76	1.91	0.06
IVth instar Nymph	71	8	11.27	0.89	0.13	6.10	1.85	0.05
Vth instar Nymph	63	15	23.81	0.76	0.31	15.00	1.80	0.12
Adult	48	48	100.00	0.00	0.00	0.00	1.68	0.00
K = 0.32								

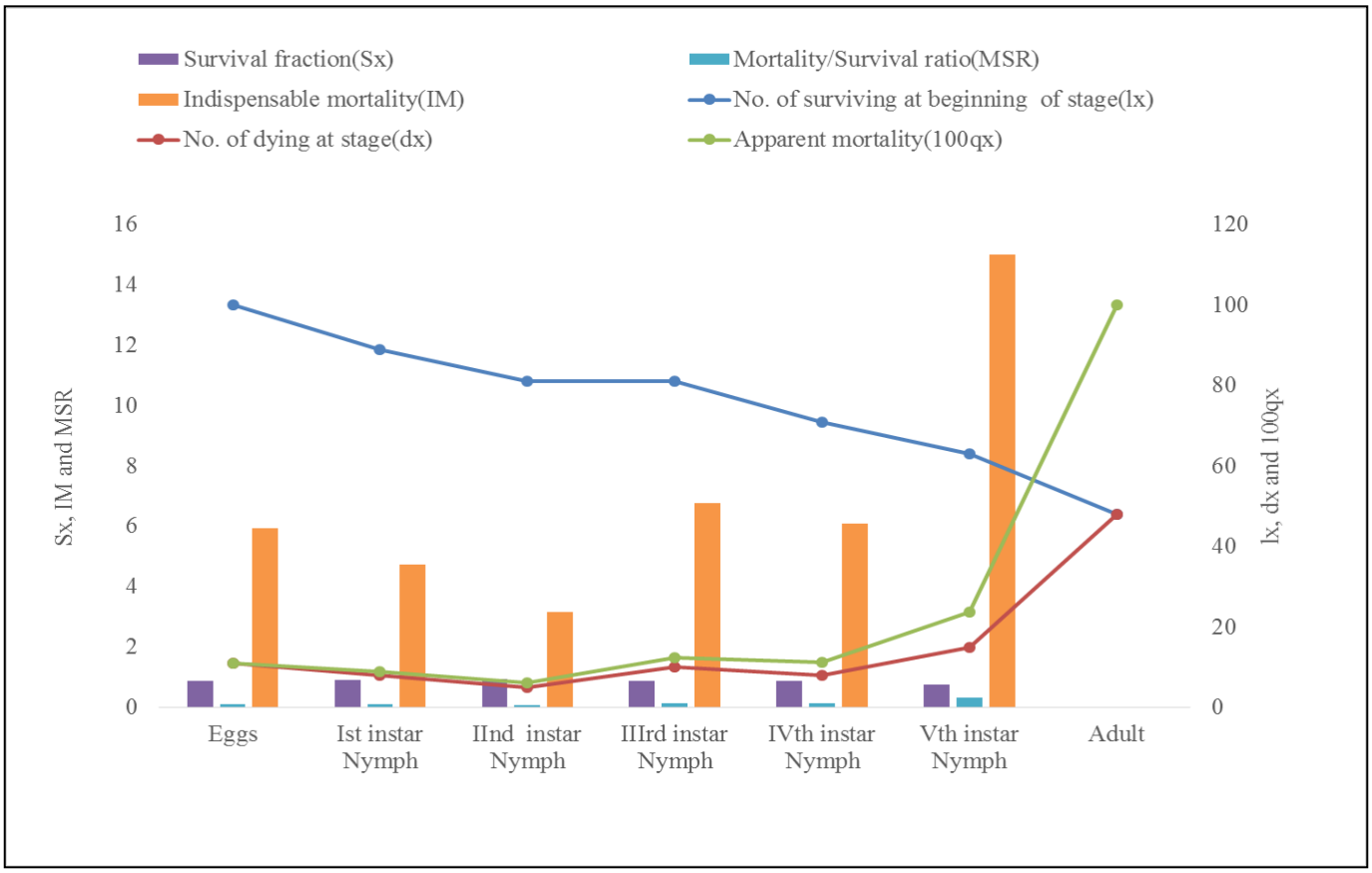

Fig 2: Stage specific life table of *Nilaparvata lugens* Stal. on Pusa Basmati –1

Table 2: Stage specific life table of *Nilaparvata lugens* Stal. on Pant Dhan–12

Stages (X)	No. of surviving at beginning of stage (lx)	No. of dying at stage (dx)	Apparent mortality (100qx)	Survival fraction (Sx)	Mortality/Survival ratio (MSR)	Indispensable mortality (IM)	log lx	k-values
Egg	100	12	12.00	0.88	0.14	5.73	2.00	0.06
Ist instar Nymph	88	9	10.23	0.90	0.11	4.78	1.94	0.05
IInd instar Nymph	79	6	7.59	0.92	0.08	3.04	1.90	0.03
IIIrd instar Nymph	78	11	14.10	0.86	0.16	6.90	1.89	0.07
IVth instar Nymph	67	9	13.43	0.87	0.16	6.52	1.83	0.06
Vth instar Nymph	58	16	27.59	0.72	0.38	16.00	1.76	0.14
Adult	42	42	100.00	0.00	0.00	0.00	1.62	0.00
K = 0.38								

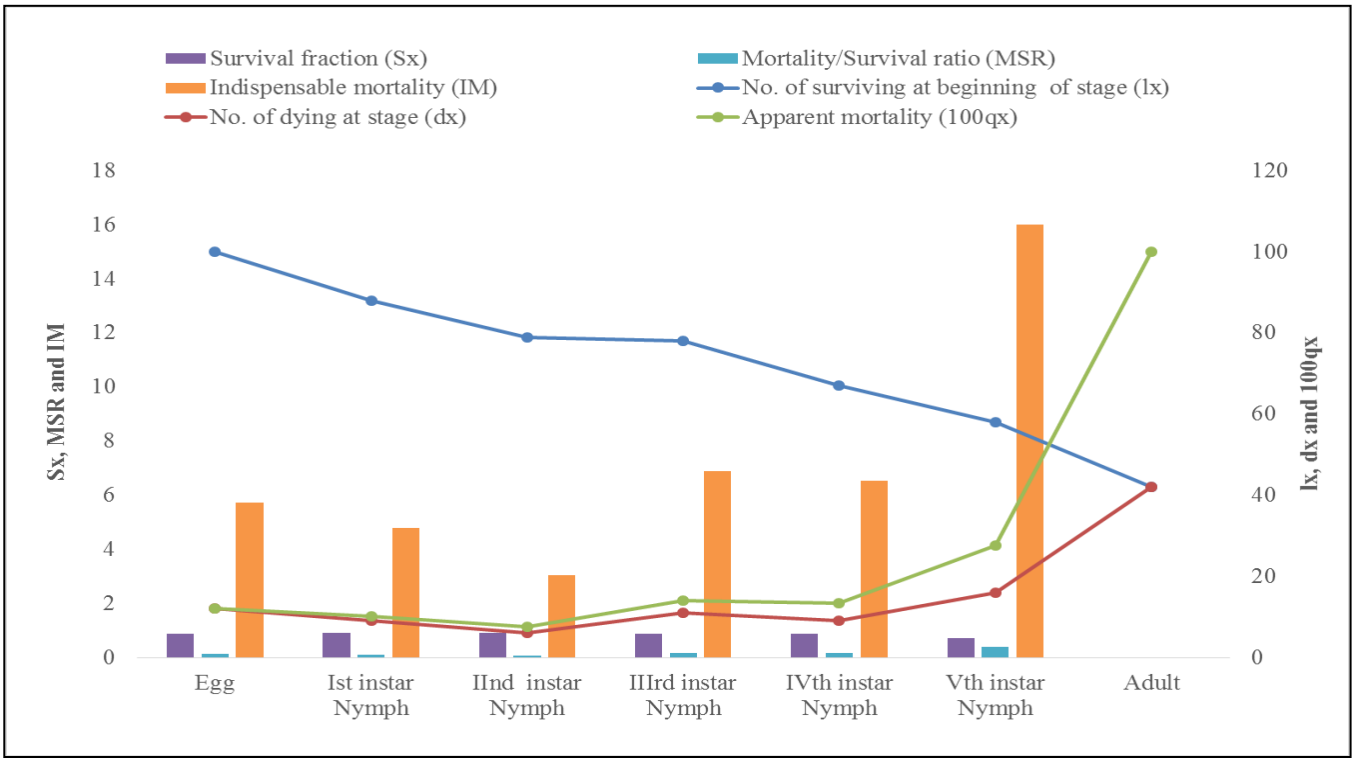

Fig 3: Stage specific life table of *Nilaparvata lugens* Stal. On Pant Dhan–12

4. Summary and Conclusion

The data taken on the stage specific life-table exhibited the highest apparent mortality were 27.59 and 23.81 percent at 5th instar nymph stage on Pant Dhan-12, and Pusa Basmati-1, while minimum apparent mortality 6.17 and 7.59 percent was recorded at 2nd instar nymph stage on Pusa Basmati-1 and Pant Dhan-12. As far as the highest survival fraction were 0.94 and 0.92 at 2nd instar nymph stage on Pusa Basmati-1 and Pant Dhan-12, while minimum survival fraction 0.76 and 0.72 at 5th instar nymph stage on Pusa Basmati-1 and Pant Dhan-12. However, there was the little variation in the value obtained at diverse developmental stage. The maximum mortality survival ratio were 0.31 and 0.38 exhibited at 5th instar nymph stage on Pusa Basmati-1 and Pant Dhan-12, while minimum MSR 0.07 and 0.08 at 2nd instar nymph stage on Pusa Basmati -1 and Pant Dhan-12. The k-values obtained at the different developmental stages were of different significance. The summation of all the K-values on both rice variety revealed that the total generation mortality was maximum 0.38 on Pant Dhan-12, while minimum was 0.32 recorded on Pusa Basmati-1.

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6. References

1. Birch LC. The intrinsic rate of natural increase of an insect population. Journal of Animal Ecology. 1948; 1(17):15-26.
2. Food and Agriculture Organization of the United Nation Rice Market Monitor Report. 2017; 20(4):265-270.
3. Hu Liang-Xiong, Zhang Hsin Chi Jie, Zhou Qiang, Zhang Run- Jie Life-table Analysis of the Performance of Nilaparvata lugens on Two Wild Rice Species. Journal of Economic Entomology. 2010; 103(5):1628-1635.
4. Khan A, Singh H, Kumar A, Kumar K, Mohd V. stage specific life-table of bivoltine hybrid race fc1×fc2 of mulberry silkworm (*Bombyx mori* Linn.) under varying temperature Annual of Entomology. 2016; 8(34):47-51.
5. Rohman A, Siti H, Mirza H, Dwi LS. Rice in health and nutrition. International Food Research Journal. 2013; 21(1):13-24.
6. Satpathi CR, Katti G, Prasad YG. Effect of Seasonal Variation on Life-table of Brown Plant Hopper *Nilaparvata lugens* Stal. on Rice Plant in Eastern India.

Middle-East Journal of Scientific Research. 2011; 10(3):370-373.
7. Singh H, Kumar A, Yadav RN. To study the Age specific life table of mulberry silk worm (*Bombyx mori* Linnaeus race Nistari) on two cultivar of mulberry plant. South Asian Journal of Food Technology and Environment. 2015; 1(2):175-178.
8. Singh H, Kumar A, Anjana, Kumar A. Age specific life table of mulberry silk worm (*Bombyx mori* Linnaeus race Nistari) on the different cultivar of mulberry. Journal of Pharmacognosy and Phytochemistry. 2018; 1:18-21.
9. Southwood TRE. Ecological methods with particular reference to the study of insect populations. 2nd ed. London: Chapman and Hall, 1978.
10. Vanitha K. Population Dynamics of Rice Brown Plant hopper (*Nilaparvata lugens* Stal.) in Field and Natural Enemy-Free Condition and Life-table Parameters. Madras Agricultural Journal. 2012; 99(3):136-141.
11. Zheng XM, Tao YL, Chi H, Wan FH, Chu D. Adaptability of small brown plant hopper to four rice cultivars using life-table and population projection method. Scientific Reports. 2017; 7:42399; doi :10.1038.