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Biology of whitebacked plant hopper , *Sogatella furcifera* on basmati rice under agroclimatic condition of Haryana

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ABSTRACT

The whitebacked planthopper (WBPH), *Sogatella furcifera* (Horvath) is an important pest of rice (*Oryza sativa* L.). The objective of this study was to examine the biology of pest under agro-climatic condition of Haryana, India during *Kharif*-2012. Observations were taken to examine the site of oviposition, hatching, per cent larval duration, pupal period, longevity etc. The colour of adult was dull - white with blackish spot on dorsal side of abdomen with average fecundity of 132.8 eggs/ female in cluster of 5 to 30 eggs. The highest number of eggs (71.96%) were laid on leaf sheath of plants followed by midrib (16.66%) and stem (11.36%). The average incubation period was 8.6±0.24 days with 84.21 per cent hatching. Maximum hatching of eggs was observed during morning hours. WBPH completed its post - embryonic development in 42.09 days (male) and 44.4 days (female) and passed through five nymphal instars to become an adult with 89 per cent larval survival and 89±0.05 per cent moth emergence. Adult male was short lived 14.4 days as compared to female (15.9) days with 1.0:0.78 sex ratio. This study provides detailed information on the morphological peculiarties of immature stages with the duration required for the completion of life cycle.

Key words: Biology, Fecundity, Hatchability, Rice, *Sogatella furcifera*.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop feeding more than half of the world population. In India, it is grown on an area of 36.95 million hectares with a production of 95.98 million tonnes. While in Haryana, it is primarily grown in Northern and Central part of the state and occupies an area of 12.45 million hectares with a production of 34.72 million tonnes (Anonymous, 2011). The rice production in India is constrained due to number of factors of which insect-pests are quite important causing more than 30 per cent yield losses. More than 100 species of insects are known to attack the rice crop, out of which 20 are of major economic significance. Rice crop in India suffered about 25% yield loss due to insect pests during 2007-08, amounting to 32 million tonnes of rice worth Indian rupees 240 billion (Dhaliwal *et al.* 2010). Annual yield loss to rice caused by planthoppers alone was one million tonne during 1970-1990 (Cheng *et al*., 2003). Plants nearing maturity also develop hopper burn if highly infested by WBPH/BPH. Amongst the sucking insect pests infesting rice, planthoppers especially the brown planthopper, *Nilaparvata lugens* (Stal), whitebacked planthopper, *Sogatella furcifera* (Horvath) and leaf hoppers are of economic concern in India. The whitebacked planthopper was first reported to cause very heavy damage in Kapurthala, Ludhiana, Karnal, Gurgaon, Sangrur and Ambala district of joint Punjab in 1966 (Atwal *et al.* 1967). Both the nymphs and adults feed on the stem and leaf sheath and remove plant sap, resulting in leaf yellowing, reduced tillering and plant height, and unfilled grains. Under high insect population, excessive removal of plant sap causes the plant to wilt, die and turn brown, a condition known as hopper burn.

One of the major factors contributing to the increase in severity of this insect is the indiscriminate use of insecticides, which also kill many natural enemies. Further, now a days insecticidal residues in *Basmati* is a big issue at national and international levels now-a-days. Therefore, to avoid colossal economic losses, it is essential to adopt a more sophisticated pesticide management measures as a part of an integrated pest management approach. Before, developing pest management strategies of a particular pest, it is pre-requisite to study the biological aspects of that pest. Biology of *Sogatella furcifera* has not been studied under agroclimatic condition of Haryana. Therefore, purpose of this work was

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to study the biological (life cycle) and behavioral aspects and to relate these biological variables to abiotic factors as a basis in developing sound and efficient pest management tactics.

MATERIALS AND METHODS

Experimental site: The study on biology of *Sogatella furcifera* (Horvath) was conducted in laboratory and screen house of Chaudhary Charan Singh Haryana Agricultural University, Rice Research Station, Kaul (29°51' N latitude, 76°41' E longitude) Haryana, India. The 10 days old seedlings of *Taraori Basmati* from earthen pots were uprooted and transplanted in plastic pots (15 cm high and 11 cm diameter) as per requirements of different experiments. The pots were watered daily and recommended dose of fertilizers was applied at suitable intervals to keep the plants healthy and kept in screen house (Fig-1). The nymphs and adults were collected from farmer fields of village Nigdu in district Karnal (Haryana). The culture was initiated by infesting the 55 to 60 days old potted plants kept in cages (100x60x100 cm).

Incubation period and percent hatchability: Two pairs of adults (upto 24 hr of emergence) were released in a cage. The eggs laid on different parts of the plant were observed visually after 24 hours. The plants used for studying the site of oviposition were also used for recording incubation period, and percent hatchability. For observation on per cent hatchability, plants were cut from the base and total eggs laid hatched and unhatched eggs were counted under microscope.

Nymphal duration and number of instars: In order to determine the number and duration of the nymphal instars, 20 newly hatched nymphs were released singly on 20 days old rice seedlings in test tubes (2.5x12 cm), The interval between two moultings was taken as duration of the nymphal instar and the total nymphal period was the period elapsed between the time of release of a newly hatched nymph and the attainment of adult stage.

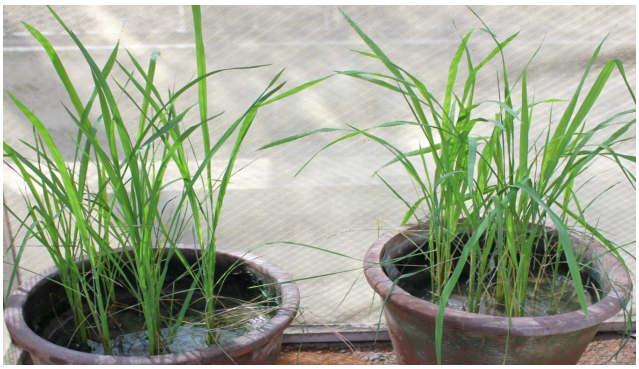

FIG 1: Potted plants of *Taraori Basmati* for rearing of whitebacked planthopper

Nymphal survival, adult emergence and sex ratio: Newly emerged nymph in batch of 20 each with five replication were released on plant covered with mylar cage (12x65 cm) (Fig-2).The percentage of survival of nymphs was calculated. The adults emerged in this experiment were killed with an insecticide and sorted out the male as well as female and sex ratio was worked out.

Pre-oviposition, oviposition, and post-oviposition period: The mating behaviour of adult was observed visually. The period from the emergence of a female to the laying of the first egg (pre-oviposition) and first egg to the last egg was considered as the oviposition period. The duration from laying of the last egg to the death of the female was considered as post-oviposition period. The food (seedling/plant) was changed daily in the morning until the death of last female.

Longevity and fecundity: The longevity of insect (male and female) was taken as the period from emergence of adult to its death and the total number of eggs laid during ovipositional period represents the fecundity.

RESULTS AND DISCUSSION

Number of eggs, site of oviposition and ovipositional behavior: The number of eggs laid by females varied from 119 to 158 eggs with an average of 132.8 eggs per female (Table-3). The eggs were thrust in a straight line on leaf sheath, midrib and stem in cluster of 5 to 30 eggs. The eggs were not visible before the hatching. However, after hatching ovipositional scar which were yellowish to brownish in colour were visible after 3 to 4 days of egg laying. After hatching, silvery white caps of the eggs were seen at the site of egg laying. The maximum eggs (71.96%) were laid on leaf sheath

FIG 2: Caged plants of *Taraori Basmati* for the study of the nymphal survival

of plant followed by midrib (16.66%) and stem (11.36%) (Table-1). Therefore, leaf sheath of plant followed by midrib were most preferred by the female for egg laying, this corroborated the observations recorded by Atwal *et al.* (1967).

Incubation period and hatchability: Maximum hatching of eggs was observed during morning hours. The eggs hatched in 5 to 9 days with an average of 8.6±0.24 days (Table-2), corroborating the findings of Vaidya and Kalode (1981) who reported the incubation period as 6 to7 days with an average of 6.4 days The percent hatchability was 84.21 per cent. The present findings are in conformity with that of Ammar *et al.* (1980). The freshly hatched nymph was greyish white in colour and remained stationary /seated on ovipositional scar 10 to 15 minutes and during this period the nymphs rubbed the last pair of its legs on the plant surface. Thereafter, it started moving upwards and reached the drooping place of the leaf. It indicated that the young nymphs avoided the direct sun light. The rice plant tissues around egg-group deposited by adult female became yellow in colour.

FIG 3: Different instars of nymphs of whitebacked planthopper on *Taraori Basmati*

Duration of nymphal instars: The nymph passed through 5 instars. Mean duration of 5 instars was 2.05±0.05, 2.3±0.12, 2.6±0.11, 2.7±0.10 and 2.95±0.11 days with range of 2 to 3, 2 to 4, 2 to 3, 2 to 3 and 2 to 4 days, respectively with an average nymphal period of 12.6 days (Table-3),(Fig-3). These findings are in agreement with some earlier researchers (Atwal *et al.* 1967; Misra,1980; Vaidya and Kalode,1981) who observed the duration of the 1st, 2nd, 3rd, 4th and 5th instars as 1.9, 1.5, 2.2, 3.9 and 4.5 days, respectively with total nymphal period of 8.9±0.5 days during August and 13.1±0.4 days during mid - September to end of September,13.9 days and 14 days, respectively.

Nymphal survival and sex ratio: The nymphal survival did not differ significantly among the intervals. It was maximum (94.00%) on 4th day after release and decreased gradually thereafter. Only 89 per cent nymphs survived on 16th day and nymphs emerged as adults (Table-3), (Fig-2). The results are in line with Ramaraju *et al.* (1989) who reported nymphal survival as 86.60 per cent. In present findings, male to female ratio of adult was 1.0:0.78 indicating the preponderance of males. The dominance of males has also been observed by Win *et al.* (2009) with sex ratio of 1.0:0.88.

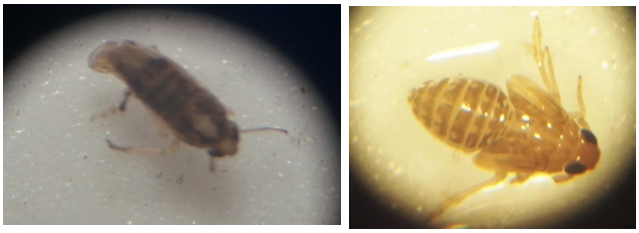

FIG 4: Adult and nymph of whitebacked planthopper *Sogatella furcifera*

TABLE 1: Ovipositional preference of *Sogatella furcifera* on plants of *Taraori Basmati* rice.

Plant parts observed	Proportion of laid eggs (%)
Leaf sheath	71.96
Midrib	16.66
Stem	11.36

Minimum temperature: 24.7 (21-26ºC)
Maximum temperature: 30.1 (32-29ºC)
Relative humidity: 51.66-85%

TABLE 2: Incubation period and hatchability of eggs of *Sogatella furcifera* on plants of *Taraori Basmati* rice

	Incubation period (Days)	No. of eggs hatched on different days after egg laying					Total hatchability of eggs (%)
		5th	6th	7th	8th	9th	
Average ± SE	8.6± 0.24	45.4± 29.98	166.0± 29.33	210.8± 18.98	108.2± 7.76	39.6± 18.16	84.21
Range	5-9						

Total number of eggs observed: 495
Minimum temperature (ºC): 24.7 (21-26)
Maximum temperature (ºC): 30.1 (32-29)
Relative humidity (%): 51.66-85

TABLE 3: Biology of white backed plant hopper *Sogatella furcifera* on rice *cv. Taraori Basmati*

Stages	Average	Range	No. of individuals observed	Temperature range (oC)	Relative Humidity range (%)
A. Stages					
Nymphal period (days)	12.6	11-14	20	24.1-30.6	67.5-83
I instar	2.05±0.05	2-3	20	24.1-30.6	67.5-83
II instar	2.3±0.12	2-4	20	24.1-30.6	67.5-83
III instar	2.6±0.11	2-3	20	24.1-30.6	67.5-83
IV instar	2.7±0.10	2-3	20	24.1-30.6	67.5-83
V instar	2.95±0.11	2-4	20	24.1-30.6	67.5-83
Per cent Nymphal Survival	89±0.05	89-94	100	21.6-31.3	61.4-84.6
B. adult stages			**Pairs**		
Male longevity(days)	14.4	11-16	10	13.9-27.7	61.4-84.6
Female longevity (days)	15.9	12-19	10	13.9-27.7	61.4-84.6
Pre-oviposition period (days)	3.7±0.30	2-5	10	13.9-27.7	61.4-84.6
Oviposition period (days)	10.2±0.51	9-13	10	13.9-27.7	61.4-84.6
Post-oviposition period (days)	2.0±0.29	1-4	10	13.9-27.7	61.4-84.6
Fecundity / female	132.8	119-158	10	13.9-27.7	61.4-84.6

Reproductive biology (Pre-oviposition, oviposition and post-oviposition periods): The pre-oviposition, oviposition and post-oviposition periods ranged from 2 to 5 days, 9 to 13 days and 1 to 4 days with an average of 3.7±0.30, 10.2±0.51and 2.0±0.29 days, respectively (Table-3). Vaidya and Kalode (1981) reported pre-ovipostion period of 3 days and oviposition period as long as 12 days give support to the present findings.

Longevity and fecundity: The male survived for 11 to 16 days with a mean of 14.4 days while female survived for 12 to 19 days with a mean of 15.9 days indicating shorter life of males than females. These findings are in confirmity with the observation made by Ammar *et al.* (1980) who also reported shorter life (12.5 days) of males than females (18.7 days). The number of eggs laid by females varied from 119 to 158 eggs with a mean of 132.8 eggs per female (Table-3) confirming the findings of Vaidya and Kalode (1981) who recorded the fecundity of *Sogatella furcifera* as 164 eggs per female.

WBPH has been quite serious in Haryana, heavy infestation cause hopper burn. Effective IPM strategies have not yet been developed to control this pest under agro-climatic conditions of Haryana. The results of our study suggest that key period for adoption of control measures for *Sogatella furcifera is* August- September. Control measures such as use of recommended insecticides should be used during this period. Additional studies such as developing IPM modules are still required for effective management of this pest.

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