Studies on Growth and Development of *Oxya japonica* (Orthoptera: Acrididae) on *Andropogon sp.* Under Laboratory Conditions

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Abstract
Oxya japonica is one of the important agricultural insect pest which feeds on a few graminaceous species. Laboratory experiments were carried out during 2012-2014 to understand the biology of *O. japonica*. The study on the growth and development of *O. japonica* revealed that the single female laid 3-9 egg pods during the entire life span. The egg pods were yellowish-brown in appearance, each containing on average 25.17±0.52 eggs. The average pre-oviposition period, average oviposition period and average post-oviposition period was recorded to be 6.15±0.49, 17.4±1.55 and 5.15±1.48 days respectively. The average longevity of male and female was 35.99±0.94 and 39.21±0.43 days, respectively. The life history included five instar stages.
Keywords: *Oxya japonica*, oviposition, longevity.

Introduction

Rice is the main staple food for most people of the Asian countries as it is the important source of carbohydrates. The rice grasshopper, *Oxya japonica* is widely distributed throughout – Asia, Africa, Northern Africa and Algeria. It is an oligophagous insect, which feeds on a few graminaceous species. As the name suggests, rice grasshopper usually feeds on rice and is considered as one of the most important agricultural pests causing reduced crop yield (Hollis, 1971).

Life history and life cycle of different species of Orthoptera were studied in the laboratory as well as field conditions by various workers (Sharma and Gupta, 1997). Bhat and Qadri (1999) studied the micro distribution and fidelitic status of Orthoptera populations in grasslands of Dachigam National Park of Kashmir region. Biology and taxonomic parameters of some short horned grasshoppers from sub-shivalik plains of Jammu region were studied by Sharma and Gupta (1997). Further, significant contribution to grasshopper fauna of Kashmir was made by Bei-Beinko and Mishchenko (1951). Mahmood and Yousuf (1999) recorded Oedipodinae (Acrididae: Orthoptera) from Azad Jammu and Kashmir with the description of a new species *J. Orth.*

Various grasshopper species compete with humans for different plant resources all over the world (Dempster, 1963). In Africa, Australia and Asia, the grasshoppers are generally termed as 'locusts' for their aggressiveness, gregariousness and swarm forming behavior. They often cause extensive and serious damage with their potential of invading cropping areas in swarms of millions of individuals leaving behind devasted fields and plantations. Destruction of rice by grasshoppers is a major factor responsible for low level of subsistence in many tropical countries. For managing such pests information on biology is essential and the stadial time of each instar stage should be known which is not available in literature. Also, the control strategies would be ineffective without a comprehensive knowledge of the biology of the insect.

Material and Methods

The present research investigations were conducted under laboratory conditions. The adult grasshoppers and various immature nymphal stages of *O. japonica* were mostly collected from cultivated rice fields and other surrounding vegetation of grasses from different climatic zones of Kashmir province, during months of May-September in the year 2012. The collections of insects was made from 9:00 to 12:00 noon with the help of insect collecting net and were mass reared in cage measuring 112×82×82 cm, which served as the stock culture. Green leaves of *Andropogon sp.* were clipped and placed into 50 ml conical flask filled with water. Two sides of the cage were made of wood, fitted with windows to clear the grasses and transferring the insects. The other two opposite sides were made of glass and wire mesh respectively. The floor of the cage was made of wire mesh provided with six holes each containing the metallic tube, each measuring 11cm in length and 3 cm in diameter, filled with moist sterilized sand which provided pseudo earth for oviposition. The cage was fitted with the temperature apparatus to maintain the constant temperature. Each cage was provided with a number of plant twigs for perching, moulting and for basking. The humidity of the cage was maintained by placing petridish containing moist cotton in the cage.

Eggs taken from cultures were kept in petridish for observing the incubation period. Newly emerged nymphs were transferred to fresh tender shoot kept in glass jars measuring 15×5 cm individually and fed twice per day as per experimentally designed conditions of food at a temperature of 30°C with 75±5 % RH. Total nymphal durations were recorded for each instar based on moulting and mortality.

The adults were sexed by examining the size, as the abdomen of female was slightly larger than the male. A pair of adults was released in each glass jar covered with muslin cloth and secured with rubber band. The host food plant provided in each glass jar was Andropogon. The jars were maintained at 30°C and 65% relative humidity. Adult longevity, pre-oviposition and oviposition period, pre-mating and mating period was recorded for each pair. All observations were replicated ten times upto successive two generations. The collected data were used to compute per cent adult survival, adult emergence, fecundity and fertility.

The statistics parameters i.e mean and standard deviation were obtained using MS Excel software 2007.

Results and Discussion

The mean pre-oviposition period of *O. japonica* varied from 5.8±0.65 days in 2012-13 to 6.5±0.02 in 2013-14. Mean oviposition period was 16.3±0.36 and 18.5±0.35 days respectively, for the two years. Eggs were laid in egg pods, which were barrel in shape with yellowish-brown colour. Egg pods are curved, about 10-12 mm in length and about 5mm in breadth. Mean number of eggs per pod was recorded to be 25.17±0.52. Mean post-oviposition period varied from 6.2±0.01 days in 2012-13 to 4.1±0.03 days in 2013-14 (Table 1).

There were five nymphal instars in the entire life cycle and the total nymphal period was 59.4±1.12 days and 60.3±1.04 days for the two years respectively. The mean head capsule width was found to be 1.08±0.02, 1.90±0.06, 3.06±0.07, 3.15±0.14 and 4±0.01 mm for I, II, III, IV and V instar, respectively. Nymphs were green in colour and active. The mean body length (mm) of different nymphal instars has been recorded to as (6.41±0.02; 6.45±0.04), (7.25±0.25; 7.22±0.36), (13.36±0.36; 13.36±0.36), (21.66±1.06; 20.97±1.03) and (27.57±1.21; 27.23±1.07) during both the years, respectively. On an average the total development period from egg to adult emergence ranged from 75.33±0.95 in 2012-13 to 78.11±1.18 in 2013-14. The female fecundity for the two years was recorded to be 3.3±0.07 and 4.6±0.12 egg pods per female for the two years, respectively (Table 1).

On an average the adult emergence ranged from 70.85±1.15 percent in 2012-13 to 75.21±1.25 percent in 2013-14. Adult longevity of male was 35.32±1.65 and 36.66±0.65 days for the two years respectively, while it ranged for female from 38.90±0.85 days in 2012-13 to 39.52±0.96 days in 2013-14. Adult longevity was more in female than the male. The adult females appeared larger in size than females, with the robust abdomen (Table 1).

Table 1: Life history, growth and development of O*xya japonica* on *Andropogon sp.* (2012-2014)

Parameters	Generation		Range	Mean ± SD
	I	II		
Nymphal period(days)	59.4±1.12	60.3±1.04	58-61	59.85±0.63
Head capsule width (mm ± SD)				
I instar	1.06±0.01	1.1±0.01	1-1.5	1.08±0.02
II instar	1.95±0.15	1.86±0.05	1.5-2.1	1.90±0.06
III instar	3.01±0.01	3.12±0.01	2.5-3.5	3.06±0.07
IV instar	3.25±0.05	3.05±0.10	3-3.9	3.15±0.14
V instar	3.99±0.91	4.01±0.01	3.5-4.2	4±0.01
Total body length (mm ± SD)				
I instar	6.41±0.02	6.45±0.04	6.2-7.0	6.43±0.02
II instar	7.25±0.25	7.22±0.36	7-8.5	7.23±0.02
III instar	13.36±0.36	13.36±0.36	13.1-4.3	13.40±0.06
IV instar	21.66±1.06	20.97±1.03	19.8-2.1	21.31±0.48
V instar	27.57±1.21	27.23±1.07	25.3-7.6	27.4±0.24
Adult emergence (%)	70.85±1.15	75.21±1.25	67-78	73.03±3.08
Total development period (days)	75.33±0.95	78.11±1.18	66-82	76.72±1.96
Adult longevity-female (days)	38.90±0.85	39.52±0.96	36-44	39.21±0.43
Adult longevity-male (days)	35.32±1.65	36.66±0.65	34-42	35.99±0.94
Pre-oviposition period (days)	5.8±0.65	6.5±0.02	5.5-8	6.15±0.49
Ovipositional period (days)	16.3±0.36	18.5±0.35	15-20	17.4±1.55
Post-oviposition period (days)	6.2±0.01	4.1±0.03	3-8	5.15±1.48
Fecundity (eggs pods /female)	3.3±0.07	4.6±0.12	3-9	3.95±0.91
Eggs per pod	25.54	24.8	23-28	25.17±0.52

A progressive increase in size of head capsule and body length was observed in the successive instar nymphs during post embryonic development. The results were in confirmation with those of Chapman *et al.* (1997) who found the similar results in *Z. variegates.* Growth was observed to be rapid during the instar stages, as the insect undergoes moulting. The gradual increase in the body length supports Ademolu and Idowu (2011) observation that there is increase in the microbial load of *Z. variegates* gut as it moults from first instar to adult stage and it enables to accommodate the increase in food consumption during the post embryonic development.

The results suggest that *O. japonica* is a highly fertile species and is fecundity is highly affected by various abiotic factors like food quality, temperature and humidity. The number of instars recorded in the present study was five. The stadial time of lower instars (I – III) was much lower than those of the higher instars (IV – V) and adults, owing to the rapid development of early instars. The total time nymphal period was observed to be 59.85±0.63 days. It is noteworthy that the lower instars (I-III) are easier to control due to the simplicity in their structural organization and physiology. These findings may have major agro-economic importance.

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