The grasshopper, *Gastromorpha transversa* Thumb., primarily is a grass-feeder, but also attacks on a variety of crop plants. It occurs throughout the tropical countries. In India it is distributed almost throughout the whole country. Collection of the grasshoppers was made from the University Zoological Experimental Field Station and from the surrounding fields having weeds and found in masses.

In order to study the development of grasshoppers in the laboratory, observations were first made at constant temperature $32 \pm 1^\circ C$ and $65 \pm 5$ per cent relative humidity and fed on *Cynodon dactylon* Pers. leaves.

The adults are of variable colour. They emit an offensive secretion when caught by hand. The female is larger in size than the male. For the biometric changes in the gonads during the maturation, it was found that gonads increase in size due to the development of fat body, accessory glands and the eggs. The number of ovarioles varies in different adult females and even in the right and left ovaries of an individual. With advancing age, the ovarioles increase in number and the loss incurred during the first oviposition is thus made up by the formation of more
eggs from the rudiments. Weight also increases with maturation, later it fluctuates after each oviposition. The regression of length of egg₂ on egg₁ and length of body on weight of body is significant.

The male and female do not mature at the same time. The pre-copulation period is 6.8 ± 0.249 days in males and 8.7 ± 0.358 days in females. The copulation is of acridian type, lasting for 30 to 50 minutes, but the copulating pairs show intraspecific variation during the process. After 6.2 ± 0.333 days of copulation, female selects a suitable site and starts laying eggs. The eggs are enclosed in an egg-pod formed of a frothy secretion from the body. After the eggs are laid, the female retracts its abdomen and plugs the egg-pod by the same secretion. The whole process lasts for about 30 to 50 minutes. The average oviposition and post-oviposition period is 16.9 ± 1.495 and 2.0 ± 0.421 days respectively.

The egg-pods are more or less cylindrical in shape measuring 40 to 65 mm in length and 5 to 7 mm in diameter. The average number of egg-pods laid by an isolated female is 4.1 ± 0.457 pods and the average number of eggs per pod is 46.5 ± 3.948, and thus the average fecundity is 190.65 eggs.

The freshly laid eggs, each measuring 5.5 mm in length and 1.2 mm in diameter, are pale-yellow changing to light brown. The average incubation period is 18.0 ± 0.311 days. The vermiform
larva takes 2 to 5 minutes to pass through the intermediate moulting.

A variation of 5-7 instars has been recorded in the hoppers under isolated condition. Among the isolated males 90 per cent hoppers were found to have 5-instars and 10 per cent 6-instars. Rarely 12 per cent hoppers were also recorded to have only 4-instars when fed on wheat plants. Among the isolated females about 80 per cent have 6-instars and 20 per cent 7-instars. The total average hopper duration for 4-5- and 6-instar isolated male is $34.64 \pm 0.299$, $38.40 \pm 0.400$ and $35.0 \pm 0.457$ days respectively. Similarly the total average hopper duration for 6- and 7-instar isolated female is $41.64 \pm 0.423$ and $48.10 \pm 1.370$ days respectively. The colour variation has also been recorded among the hoppers of different instars as well as in the same instar. Dyar's law has also been successfully applied to the hoppers of $\text{G. transversa}$ Thumb. No obligatory diapause occurs in any stage and four generations under constant ecological conditions may be obtained in a year in the laboratory.

The effects of varying ecological factors such as temperature, relative humidity, sand moisture, food and density on the development of different stages of $\text{G. transversa}$ have also been studied.

Freshly laid eggs of grasshopper were obtained from the stock and were kept at $15 \pm 1^\circ$, $27 \pm 1^\circ$, $32 \pm 1^\circ$, $37 \pm 1^\circ$, $42 \pm 1^\circ$
and 50 ± 1°C with 4, 8 and 12 per cent moisture in sand, and observations were recorded on their development and viability. The eggs kept at 15 ± 1° and 50 ± 1°C irrespective of sand moisture did not hatch at all, but the eggs kept at 27 ± 1°, 32 ± 1°, 37 ± 1° and 42 ± 1°C with 4, 8 and 12 per cent sand moisture underwent normal development. The temperature directly affects the incubation period when it increases within the limits of favourable temperature. Sand moisture has no remarkable effect on the incubation period at a particular temperature, but it affects the viability of eggs. The viability of eggs increases to a certain extent with the increase in contact moisture and temperature. The fertility of eggs has been found to be the highest at 32 ± 1°C and 8 per cent sand moisture.

Freshly laid eggs first exposed to 10°C for 4 and 72 hours and then incubated at 32 ± 1°C, hatched in 24.3 ± 0.362 and 39.8 ± 0.622 days respectively, and the viability of eggs is 43.9 ± 2.463 and 23.6 ± 1.498 per cent respectively. Thus the exposure of eggs to low temperature results in an increase in incubation period and decrease in the hatching percentage of eggs. But this increase or decrease depends on the duration of exposure to low temperature.

The incubation period of the eggs which are first incubated for 5, 10 and 15 days at 32 ± 1°C and then exposed for 4 hours at 10°C, and again at 32 ± 1°C till they hatched out, is 20.2 ± 0.321, 21.1 ± 0.462 and 21.8 ± 0.130 days respectively, and the viability
of the eggs is 49.7 ± 1.241, 61.1 ± 2.361 and 68.4 ± 0.362 per cent respectively. It may, therefore, be concluded that the development in the advanced stages is not as adversely affected by low temperature as in the early stages. The incubation period and viability of eggs increases with the advancing stage of developing eggs exposed to low temperature.

In cases where the freshly laid eggs are first incubated for 0, 5 and 10 days at 32 ± 1°C, then exposed for 1 day at 50 ± 1°C and then again incubated at 32 ± 1°C till hatched out, the incubation period is 17.9 ± 0.362, 17.2 ± 0.472 and 16.8 ± 0.124 days respectively, and the viability of eggs is 67.8 ± 2.320, 52.0 ± 1.212 and 44.2 ± 1.162 per cent respectively. But the eggs first incubated for 15 days at 32 ± 1°C and then exposed to 50 ± 1°C for one day and then again incubated at 32 ± 1°C, did not hatch at all. The developmental rate is decreased when the eggs in the advancing stages of development are exposed to higher temperature for one day, but the exposure of eggs in very advanced stage of development to higher temperature results in cent per cent mortality. If the time of exposure to higher temperature is raised to 3 days, then none of the eggs will hatch and hundred per cent mortality will occur.

The freshly hatched hoppers reared in isolation at 15 ± 1°C and 50 ± 1°C with 40 ± 5, 65 ± 5 and 80 ± 5 per cent relative humidity did not develop at all. Hoppers reared at 42 ± 1°C and
40 ± 5 per cent relative humidity also did not develop and died in the first instar. But 46.3 and 57.7 per cent hoppers attained the adult stage when reared at 40 ± 1°C with 65 ± 5 and 80 ± 5 per cent relative humidity respectively. The survival percentage of hoppers at 27 ± 1°C with 40 ± 5, 65 ± 5 and 80 ± 5 per cent relative humidity is 48.1, 68.5 and 51.0 per cent respectively. At 32 ± 1°C with above relative humidity, it is 67.6, 81.6 and 62.3 per cent respectively and at 37 ± 1°C with above relative humidity, the survival is 33.8, 51.0 and 53.3 per cent respectively. Thus the rate of survival of hopper instars increases with the increase in temperature, but extremes of temperature result in mortality. At constant temperature, survival rate increases with the relative humidity, but very high relative humidity (80 per cent) retards the survival percentage and results in higher mortality. Higher temperature with slightly higher relative humidity enhances the rate of survival. The hoppers develop faster at higher temperature (42 ± 1°C) and higher relative humidity (80 per cent) than at 27 ± 1°C, 32 ± 1°C and 37 ± 1°C. But the temperature beyond 42°C is lethal and unfavourable for hopper development. At low temperature (15 ± 1°C) hoppers failed to develop at all. Thus far higher and far low temperatures check the hopper development. An increase in temperature decreases the hopper duration and results in the increase of developmental index.

The development of adults reared in isolation is also affected by different levels of temperature and relative humidity.
The longest duration for pre-oviposition (18.2 ± 0.802 days), oviposition (26.1 ± 1.728 days) and longevity (45.1 ± 1.498 and 47.4 ± 1.688 days in males and females respectively) is obtained at 27 ± 1°C and 40 ± 5 per cent relative humidity, while the shortest duration for maturation (5.0 ± 0.333 days), oviposition (9.3 ± 0.472 days), post-oviposition (1.0 ± 0.256 days) and longevity (12.5 ± 0.600 and 15.2 ± 0.585 days in males and females respectively) has been recorded at 42 ± 1°C and 80 ± 5 per cent relative humidity. Thus an increase in temperature within limits of favourable temperature at constant relative humidity, accelerates the development of adults and far low and far high temperature adversely affect the development. Atmospheric relative humidity, although has no marked effect, increases only slightly the duration of pre-oviposition, oviposition, post-oviposition periods and the life span. At 32 ± 1°C and 80 ± 5 per cent relative humidity the maximum number of egg-pods is laid in the sand having 8 per cent moisture and the minimum number is obtained at 42 ± 1°C and 65 ± 5 per cent relative humidity in the sand having 12 per cent moisture. Dry sand with 0 per cent moisture is completely rejected for oviposition. Females kept at 15 ± 1°C and 50 ± 1°C failed to lay eggs irrespective of the relative humidity, but all the females (100 per cent) kept at 27 ± 1°C, 32 ± 1°C, 37 ± 1°C with 40 ± 5, 65 ± 5 and 80 ± 5 per cent relative humidity laid eggs, while at 42 ± 1°C with 40 ± 5, 65 ± 5 and 80 ± 5 per cent relative humidity only 49.6, 68.0 and 79.1 per cent of females respectively
Eviposited. The average fecundity of a female usually decreases at the temperature below or above the optimum temperature, but an increase within range of the optimum temperature, results in increased fecundity. Similarly an increase in the relative humidity results in increasing the average fecundity. The highest fecundity (206.56 eggs) is recorded at 32 ± 1°C and 80 ± 5 per cent relative humidity, while the lowest (115.68 eggs) is at 42 ± 1°C and 40 ± 5 per cent relative humidity.

Twenty different food-plants with one standard were used at 32 ± 1°C and 65 ± 5 per cent relative humidity, to determine the food preference values of the hoppers and adults. Early stages of hopper instars prefer a variety of grasses only and show low preference for crop plants. The late instar hoppers show high preference for weeds and crop plants.

Adults show high preference for the following plants arranged in descending order - *C. xanthus*, *E. solum*, *P. orientale*, *S. officinarum*, *C. ciliaria*, *O. sativa*, *T. aestivum*, *D. annulatum*, *L. stricta*, *S. dactylon*, *O. intermedium*, *A. myrtilla*, *L. vulgare* etc. while show low preference for *M. paradisiaca*, *P. turbinata*, *S. hirtum*, *E. comunis*, *T. alexandrinum*, *O. sativa* etc. *M. inidarch* is not touched at all by any stage of *G. transversum*.

The newly hatched hoppers were reared under less and more crowded conditions and fed on twenty different exclusive diets.
along with 5 mixed diets. No hoppers survived to reach the adult stage when reared on exclusive diets of *D. strictus*, *C. intybus*, *B. sativa*, *B. comosa* and *G. herbaecosa*. The highest survival (78 per cent) is obtained under less crowded conditions when fed on mixed diet of *G. dactylon* and *G. rotundus* but the survival is less (69.3 per cent) when reared under more crowded condition. The minimum percentage of hopper survival, 52.0 and 38.0 per cent, is obtained on mixed diet of *G. dactylon* and *T. aestivum*, under low and high densities. Among the exclusive diets the maximum survival, 60 and 36 per cent, is obtained on *G. rotundus* under less and more crowded conditions respectively while the minimum survival percentage, 12 and 8 per cent, is obtained under less and more crowded conditions respectively when fed on *G. corniculata*. The maximum hopper duration of male and female is 54.3 and 59.9 days respectively, when fed on *G. ciliaria* and reared under more crowded condition, while the minimum duration is 34.6 and 40.9 days for males and females respectively when fed on mixed diet of *G. dactylon* and *T. aestivum* under less crowded condition. The growth index of the hoppers also depends on the food-plants, but generally it is lowered with the increase in density.

The newly emerged adults were fed on the same food-plant on which their hopper instars had been fed. The development is found to be accelerated, when adults are fed on mixed diets, while the development is poor on exclusive diets in comparison to mixed ones.
Freshly hatched hoppers were reared in isolation and different crowded conditions. The density affects the development of hoppers. The average hopper duration reared in isolation is $34.6 \pm 0.498$ and $38.4 \pm 0.400$ days for 5- and 6-instar males respectively, while it is $41.6 \pm 0.565$ and $48.1 \pm 1.370$ days for 6- and 7-instar isolated females respectively. But the duration is longer under crowded condition amounting to $44.7 \pm 1.301$ and $45.1 \pm 0.623$ days for males and $49.8 \pm 0.426$ and $54.2 \pm 0.576$ days for females reared under less and more crowded conditions respectively.

Density has no significant effect on the morphometrics, sexual maturation, and egg-laying rate of *Gastrophora transversa*. The average maturation period of females reared in isolation and crowded conditions is $15.5 \pm 0.507$ and $15.0 \pm 0.826$ days respectively. The interval between the successive egg-laying in isolated and crowded female is $3.85 \pm 0.263$ and $3.57 \pm 0.132$ days respectively. Crowding markedly affects the oviposition and post-oviposition period. The average oviposition period of females reared in isolation and crowded conditions is $16.9 \pm 1.495$ and $10.36 \pm 0.809$ days respectively, and the post-oviposition period is $2.0 \pm 0.421$ and $1.39 \pm 0.188$ days for isolated and crowded females respectively.

The average fecundity for isolated female ($190.65 \pm$ eggs) is higher than that of crowded female ($150.10$ eggs). Similarly percentage of viability of the eggs is higher for crowded female (85.4 per cent) than that for isolated ones.
(75.38 per cent).

The hoppers of each instar and adults were kept in jars and cages under different density, fully fed and starved conditions and temperature to observe the cannibalism. The rate of cannibalism in hoppers and adults increases due to scarcity of food and crowded conditions. It occurs even after regular supply of fresh food. The crowded condition and higher temperature accelerate cannibalism, while the rate of cannibalism is less at low temperature and under less crowded condition. The hoppers were also found to consume their own exuviae.

Observations on the development of various stages of the grasshopper, in relation to different ecological factors during different months of the years 1975 and 1976, were made by collection from the Zoological Experimental Field Station, Aligarh. Regarding field observation it has been found that the weight of a mature female under natural condition corresponds to the weight of the mature female in the laboratory. The average maturation period is 14.3 days (ranging 10-16 days). The average weight of female fluctuates on each oviposition. The highest population of hoppers and adults has been recorded during August and September. Copulation is frequent from the late September till October. Oviposition occurs during March and April and also September till October. There are two generations in a year.

The population considerably decreases during the middle of the summer and winter seasons.