tissue tc increase in peroxides. At higher doses the whole of cellular metabolism is grossly impaired resulting in lower enzyme activities.

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BEHAVIOURAL COMPONENTS IN FEEDING, REPRODUCTION AND DISPERSAL OF THE GRASS SEED-FEEDING THRIPS *CHIROTHRIPS MEXICANUS* CRAWFORD

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Information on several grass-seed infesting thrips of the genus *Chirothrips* Haliday is available with reference to their ecology (Hukkinen[1]; Oettingen[2]; Riherd[3]; Ananthakrishnan[4]; Wetzel[5]; Koppa[6]; Ananthakrishnan and Thirumalai[7]), biology (Evans[8]; Ananthakrishnan and Thirumalai[9]) and male reproductive system (Pitkin[10]). Emphasis has been made in this study on the behavioural aspects relating to feeding, reproduction, and dispersal of *Chirothrips mexicanus* in the field as well as in the laboratory.

Materials and Methods

Flowers of *Chloris barbata* with pre-pupae were collected at random from the field and transferred to the collecting chamber composed of a chimney, a conical flask, and a polythene bag to obtain the emerging adults, which were reared in separate culture tubes provided with flowers of known age. Inflorescences of different ages, marked with different colour threads, were provided within the same culture tube to study the preference of *C. mexicanus* for a certain age of inflorescence both for feeding and for egg-laying. In the field, to study their pupal and adult dispersal behaviour, the inflorescences were covered with polythene bags.

Observations

Feeding

Age of the inflorescence appears to influence adult and larval feeding of *C. mexicanus*. Gravid females lay a single egg in each ovary of 7–13 day-old inflorescence. The hatching larvae, which initially feed on the ovarian surface of 13–17 day-old inflorescence, consume the single ovary fully by the time they attain the pupal stage, thus meeting their entire nutritional requirements for development. With further development the pupae remain immobile and protected within the glumes. Adults prefer ovaries of 2–5 day-old flowers with high milk content (Fig. 1), consuming an average of 11 ovaries (8–14) per day (Plate 1. A and B).

Mating and Oviposition

Biological studies of *C. mexicanus* indicate that the apterous males always emerge before females, the sex-ratio of male and female being constantly 1 : 2. During male emergence the majority of the females in the same compound spike is in the pupal stage. Subsequently, the males enter the glumes of the same compound spike and mate with the female pupae, which have developed wing buds and premature ovaries. Males are found to be polyandric. Oviposition starts 4–5 days after adult emergence and continues for 4–5 days. The adult females select the ovaries of 7–13 day-old flowers for egg-laying (Fig. 1). They enter the fertile glumes of the spikelets and by bending their abdomen slightly over the ovary, insert single eggs each at the apex of an ovary, projecting partially outside it. In the laboratory, the female on an average lays two eggs per day.

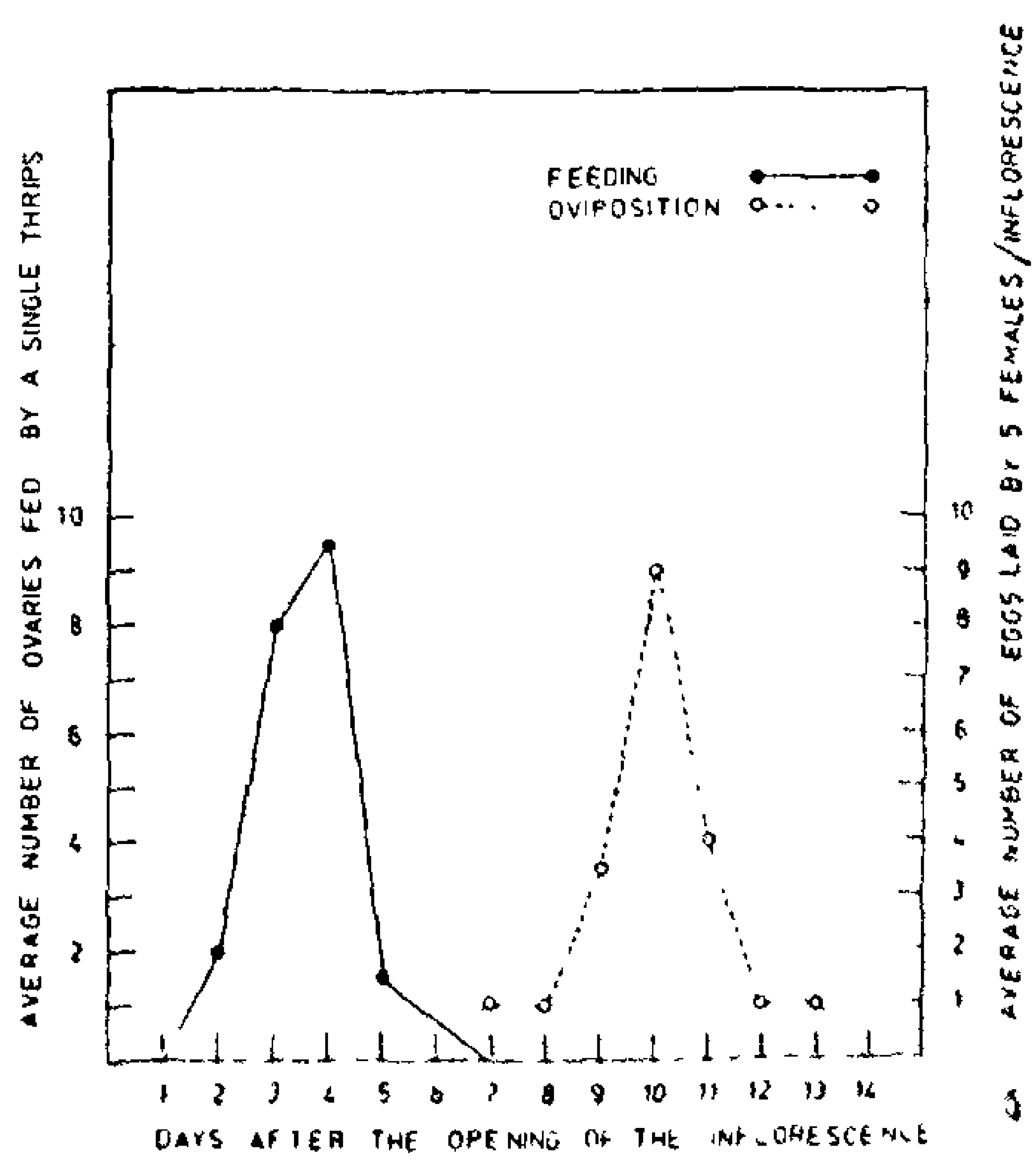
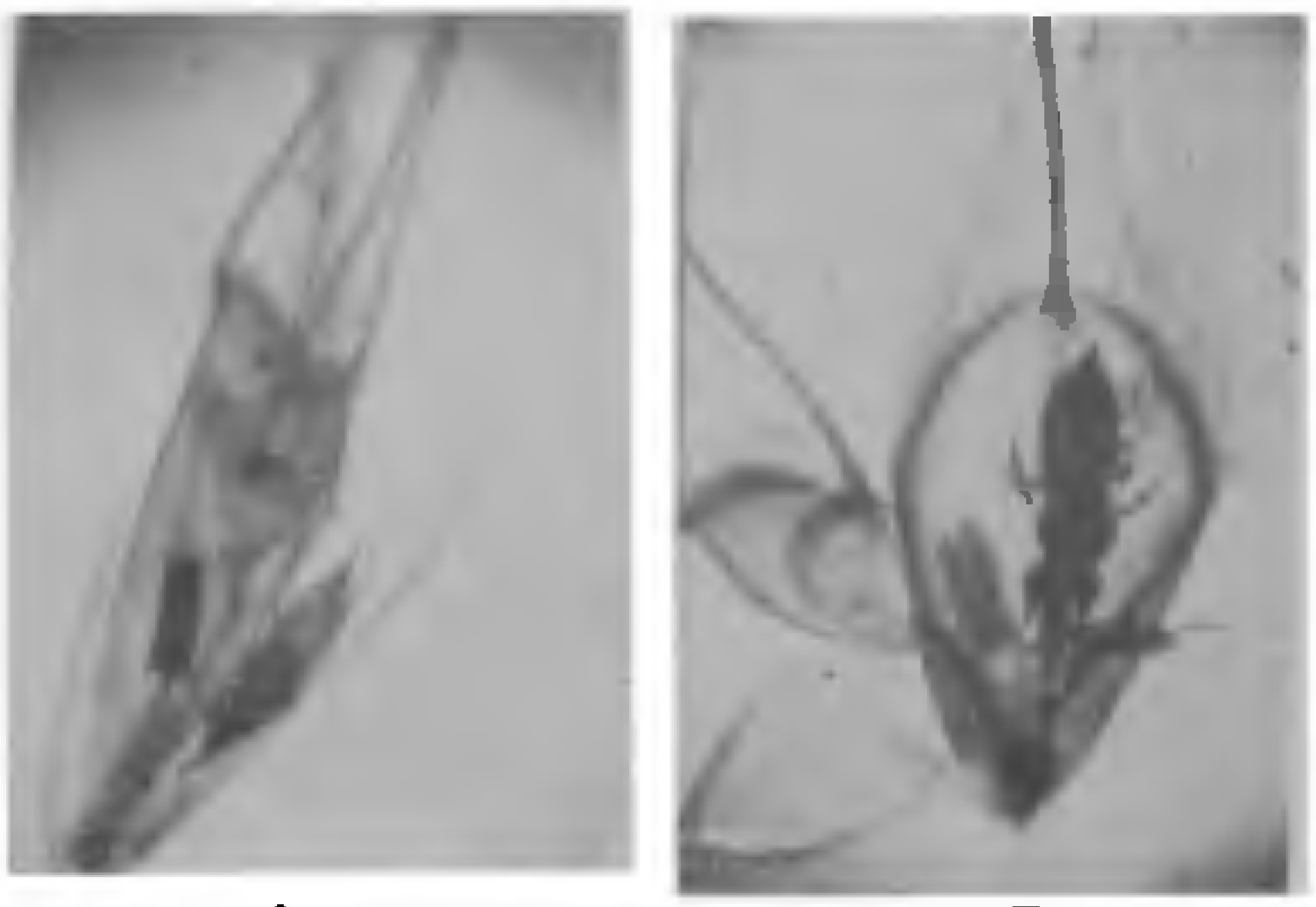


Fig. 1. Showing the preference of *C. mexicanus* to *C. barbata* ovary for feeding and oviposition.



A B

PLATE 1. *C. mexicanus* within the spikelet of *C. barbata*.

Dispersal

The migration of the males to fresh inflorescence is very much restricted because of their apterous and comparatively sluggish nature. Males usually move within the same compound spike of *C. barbata*, from where they emerged, and mate with several female pupae during their life. Two types of dispersal behaviour are observed in the females. In the first, the mated alate females emerging from eggs laid in 7–10 day-old inflorescences fly to a new inflorescnece, where they can attack fresh ovaries of *C. barbata*. The second type of dispersal observed is exhibited by the female pupae that develop from the eggs deposited in the ovaries of 11–13 day-old flowers. Such female pupae, though mated by early emerging males, fail to emerge into adult alate females before the drying up of the inflorescence. They are carried away by wind to other areas as they occupy the place of the seed. Normally they emerge 1 or 2 days after the dispersal.

DISCUSSION

The population of adult males of *C. mexicanus* reaches its peak in the first few days of adult emergence and declines rapidly thereafter. But the female population builds up gradually within 2–4 days of adult emergence. In addition, the females survive longer (30–35 days under laboratory conditions) than the males (6–7 days) (Fig. 2). The sex-ratio of *C. mexicanus* in the laboratory culture is constant, 1 : 2 (Male : Female) and is based on the total population emerging from the inflorescences. The wide range in sex-ratio from 1 : 1 to 5 : 1 (Male : Female), as obtained by Ananthakrishnan and Thirumalai[9], may be due to collection of material using the beating method in the field on different days of their emergence (Fig. 2). The high rate of mortality, especially within

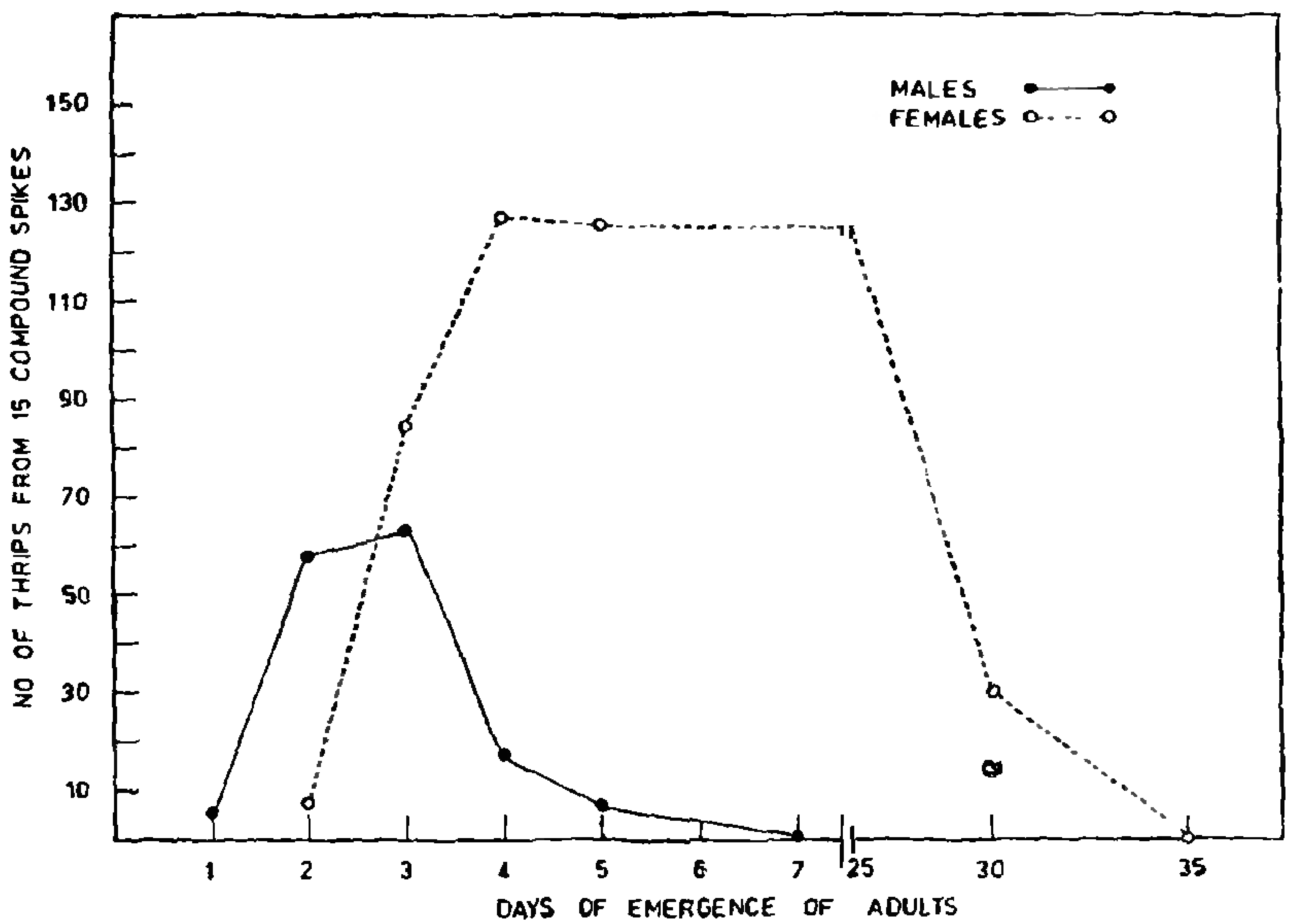


FIG. 2. Showing the emergence sequence and survival of *C. mexiconus* males and females.

23-days of emergence, when the female population is at its peak, could be the reason for the mating of adult males with pupal females. The pupal mating behaviour of this species has an advantage in that the female pupae, developing from eggs laid in old inflorescences and occupying the place of the seed, are carried away by wind to other places where there would be no males. It is also advantageous to the alate adult females that develop from eggs deposited in the younger inflorescences, as there would be no males available when such females migrate to fresh inflorescence for feeding and subsequent reproduction. This type of mating with an immature stage is not abnormal in thrips as similar observations have been made in *Limothrips denticornis* by Lewis[11]. In *C. mexicanus* the larvae feed on the ovarian tissue while the adults prefer the milk content in the ovaries of young inflorescence. The mortality of apterous males within a few days of emergence may be due to the lack of milky juice in the ovaries of the same inflorescence. *C. mexicanus* chooses a favourable habitat in the inflorescence of the grass host where the immature individuals are protected by glumes, assuring wind dispersal of the pupae. The life-cycle of *C. mexicanus* is adjusted in such a way that it is completed in the inflorescence of *C. barbata* before the host inflorescence dries up. The total duration of the life-cycle (egg to adult) is about 14–19 days while the total life span of the inflorescence (bud to seed dispersal) is about 28–32 days.

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CADMIUM-INDUCED NEOPLASIA IN *CHANNA PUNCTATUS* (BLOCH)

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Cadmium salts are obtained as by-products of zinc or lead production, and are also found in effluents in alloy, pigment, glass and paint industries. Cadmium ions when absorbed cause considerable damage to the kidney tissue which ultimately prove fatal to fish. Although toxicity of cadmium to fish has been studied by several workers[1,5] yet no neoplasia is reported as a result of cadmium toxicity. The author has observed neoplasia in the kidney of *Channa punctatus* due to cadmium toxicity.

Experimental

The fish *Channa punctatus* were collected from fresh waters of Ghaziabad district, were treated with 0·1% $KMnO_4$ to avoid any infection. The fish were then acclimatised for 15 days in the laboratory and 25 fish (8 to 13 cm in length) were transferred to test solution iu which sub-lethal concentration of cadmium (15 mg/l $CdCl_2$ $2\frac{1}{2}$ H_2O) was dissolved. The solutions were renewed after every 96 hours for a period of 30 days after which the survived fish (eleven) were sacrificed and their kidney portions fixed in neutral formalin for histopathological study. Sections of 7 mμ were cut and stained with iron haematoxylin and eosin.

Results

In the head kidney the clumping of haemopoetic tissue was observed (Fig. 1). Besides necrosed tubules the kidney showed the other changes such as degeneration of interstitial tissue and shrinkage of glomeruli. The shrinkage of glomerular capillaries, and also the swelling of Bowman's capsule, increased the Bowman's space (Fig. 2). A tumor (Fig. 3) surrounded by a sheath of connective tissue is well demarcated. Since it is encapsulated, growth is slow and localised, mitotic divisions are not visible and the cells are of uniform size and shape, the tumor is classified as benign.

Discussion

The histopathological changes that occurred in the kidney due to toxic effect of sub-lethal concentration (15 mg/l) of cadmium chloride must have caused impairment in kidney function. These pathological changes might be due to infra-renal exhaustion. This supports the view of Pflugfelder[6] who suggested that such types of changes were mainly due to physiological response to increased excretory demands. However, Rasquin and Rosenbloom[7] stated that metallic ions change the metabolic activity as a result of interaction of metallic