A STUDY OF OOCYTE DEVELOPMENT IN THE ADULT PYRRHOCORID BUGS OF THE GENUS DYSDERCUS

by

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DECLARATION

I, Gurdeep Arora, hereby declare that this is my own work and has not been presented to any other University.

October, 1971.

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SUMMARY

The genus Dysdercus Boisduval is widespread throughout the tropics and like the other Pyrrhocoridae, it associates primarily with plants of the order Malvales, with both the immature and adult stages feeding on the seeds. This genus includes a number of species that are pests of cotton. Owing to its economic potential, a number of workers have therefore carried out field studies to show the relationship of the cotton stainers to their host plants. However, comparatively little work has been done on the reproductive biology of the insects, particularly in relation to the development of the oocytes, oviposition and fecundity in females kept under controlled laboratory conditions.

A brief histological study of the ovary indicated that as in most other hemipterans, the ovary is made up of seven telotrophic ovarioles; the developing oocytes are nourished by long nutritive cords that originate from the trophic core of the germarium.

Some aspects of the reproductive biology of the females were carried out on three closely related species, Dysdercus

fasciatus Sign., D. nigrofasciatus Stål, D. cardinalis Gerst. thus allowing comparisons of the reproductive patterns as a function of variations in both the bionomics and the flight activities of the species. Of the three species, D. fasciatus was found to have the shortest pre-copulation period and the earliest mean age at oviposition. Since it is restricted to a relatively few host plants which have a distinct fruiting season and provide a large supply of food during a given period, it is likely that maximum advantage of the current favourable conditions is taken by reducing both the pre-copulation and pre-oviposition period. D. nigrofasciatus on the other hand, inhabits a greater variety of alternative host plants and hence less premium is placed on reproduction. Laboratory studies have indicated that the pre-oviposition period of D. nigrofasciatus is significantly longer ($p < 0.02$) compared to D. fasciatus. The bionomics of D. cardinalis is little known but reproductive studies have indicated that as in D. nigrofasciatus, both the pre-oviposition and pre-copulation period is longer compared to D. fasciatus.

Of the several factors that control reproduction in

insects, emphasis here has been placed on only two of these, namely, mating and nutrition. Observations on mated and virgin females of Dysdercus indicated that in both D. fasciatus and D. nigrofasciatus there were no significant differences in the adult longevity, the rate of oocyte development, pre-oviposition period, inter-oviposition period and the total number of eggs laid during the adult life. In D. cardinalis however, mating had a profound effect on the rate of development of the oocytes and hence oviposition. The other factors concerned with reproduction, as in the other two species were not influenced by mating. The various species of Dysdercus hence show a varying degree of dependence on mating, but the latter did not have such a profound effect on egg production and oviposition as was expected. This study indicated that although a characteristic feature of the reproductive biology of the cotton stainers is their long and continuous copulation during the pre- and inter-oviposition period, this sustained copulation is not necessary for egg production and hence needs further investigation.

In contrast to mating, nutrition as in most other insects had a profound effect on the development of the oocytes. Although the nymphal stages were fed throughout their period of development, the newly emerged females had to be fed for a minimum

period of 3 - 4 days before the first batch of eggs could be developed and oviposited. Following each oviposition, a new food intake is necessary for continued egg production. Even under poor nutritional conditions, there were no signs of oocyte degeneration indicating that oosorption is not of any importance in the regulation of egg production. In absence of feeding, the females could maintain life on water but oocyte development in all three species occurred up to stage where yolk deposition normally occurs. Henceforth, there was no further development and the oocytes remained small and transparent. Mating was drastically reduced in starved bugs but of the few pairs that copulated, mating did not have any effect on the development of the oocytes, even in D. cardinalis, indicating that both nutritional and mating stimuli act independently of each other. Detailed studies would be necessary to indicate whether the developing oocytes are dependent on an active neurosecretory system or available food reserves or both.

Quantitative analysis of the haemolymph proteins in D. fasciatus females has indicated that some of these proteins

are utilized for oocyte development. The haemolymph protein concentration of newly emerged adults was high at emergence and increased further within the next 24 hours of emergence. Following this increase, there was a continual decrease from day 1 to day 7 accompanied by a simultaneous development and oviposition of the first batch of oocytes indicating that the decline has most likely occurred as a result of transfer of some of these proteins into the developing oocytes. Some of these proteins may also be utilized for the somatic growth which occurs during the first few days of the adult life.

Simple flight tests carried out in the laboratory on three species of Dysdercus have indicated that there is a relationship between reproduction, flight activity and bionomics of the species concerned. Males began to fly 2 - 3 days following emergence as adults and most individuals retained their flight capability throughout life. It was in the females however, that differences in the flight pattern became evident, although there was an underlying similarity. All three species seem to have modified a basic reproductive

flight pattern. D. fasciatus females unlike the males were incapable of undertaking any flight. Within 2 - 3 days of emergence, the bugs entered a more or less continuous copulation (which would certainly prevent flight) followed by oogenesis and flight muscle histolysis. Since D. fasciatus females feed on a limited number of host plants which provide an abundant supply of food during certain times of the year, the females seem to take maximum advantage of these current favourable conditions by preventing flight and reducing both the pre-copulation and pre-oviposition period. This allows rapid population growth and colonization of the habitat. Starved females, unlike the fed females, undertook some flight. The mating frequency was reduced in starved pairs and there was no oocyte development or flight muscle histolysis indicating that under unfavourable conditions, the females are capable of undertaking flight in order to find a suitable habitat.

Both D. nigrofasciatus and D. cardinalis females however differed from D. fasciatus females in that fed females of the two former species flew for a brief period followed by oogenesis and flight muscle histolysis. Oviposition was

comparatively delayed in these species thus allowing the females to undertake sufficient flight. Maximum flight activity occurred at the time when the mating frequency was not high. There is therefore a clear separation of flight activity from reproductive activity. Since D. nigrofasciatus feed on a variety of herbaceous host plants that are apt to be scattered, the females need to undertake some flight to cover the available habitat. The bionomics of D. cardinalis is not well known but it resembles D. nigrofasciatus in both the reproductive and flight activities.

The flight activity in these species was further enhanced under starvation; there was no oögensis or wing muscle histolysis. Reduced mating frequency in starved pairs permitted more flight, the latter ceased only when feeding occurred. Since all these species face unfavourable conditions in the field, this enhanced flight activity and reduction in reproductive activity is of an ecological significance since it enables the bugs to use up the available reserves for migrating to biotopes where conditions for reproduction are favourable.