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Prey Selection by Larval *Micromus tasmaniae* Walker (Neuroptera: Hemerobiidae)

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ABSTRAK

Micromus tasmaniae *ialah sejenis serangga pemangsa yang paling kerap didapati sebagai musuh semula jadi kepada kutu daun ubi kentang di Selatan Australia. Kemungkinan keupayaan larva* M. tasmaniae *menangkap setiap instar kutu daun,* Myzus persicae *Sulzer, telah diukur pada suhu tetap 15°C, 20°C dan 25°C. Kemungkinan keupayaan menangkap* M. persicae *oleh* M. tasmaniae *meningkat selepas setiap kali bersalin kulit dan menurun sedikit sejurus sebelum bersalin kulit terutama sekali pada suhu 15°C. Kecuali bagi larva yang terlalu kecil dan remaja, larva pemangsa berupaya menangkap dengan cekap mangsa yang kecil atau besar. Larva yang remaja menunjukkan sedikit tabiat pemilihan terhadap mangsa yang kecil, manakala larva yang lebih tua tidak menunjukkan pemilihan langsung. Keberkesanan larva* M. tasmaniae *mungkin berbeza di antara musim dan iklim.*

ABSTRACT

The brown lacewing, Micromus tasmaniae, *is the most common predator of potato aphids in South Australia. The probability of capture and prey preference of larval* M. tasmaniae *were measured for each instar of* Myzus persicae *Sulzer (the green peach aphid) at constant 15°C, 20° and 25°C. The probability of capture of* M. persicae *by larval* M. tasmaniae *increased after each moult and declined just before moulting, especially at 15°C. Except for very small and young larvae, the predator larvae were able to capture efficiently both small and large prey. Young larval predators showed some preference for smaller prey, whereas older larvae exhibited little or no preference. The effectiveness of* M. tasmaniae *larvae may vary considerably between seasons and climates.*

INTRODUCTION

The Australian brown lacewing, *Micromus tasmaniae* Walker is a common and abundant predator of *Myzus persicae* (Sulzer) and other potato aphids in South Australia (Hussein, 1982). Numerical changes in the populations of *M. persicae* and *M. tasmaniae* have been studied over a 2-year period at Milang and Adelaide, South Australia by Hussein (1982). Field data are difficult to interpret without understanding the characteristics of the predator-prey interaction to provide guidance for the biological control of *M. persicae* on potatoes. Field samplings of eggs, larvae and adults of *M. tasmaniae* indicated that the brown lacewings were present throughout the year even when prey populations were very low. Its ability to survive while most other predators like the coccinellids, sryphids and chrysopids fail, signifies that *M. tasmaniae* probably has high probability of capturing its prey and has no preference for prey size or age.

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To help interpret the field observations, additional information was obtained in laboratory experiments on the probability of capture, the prey preference by larval *M. tasmaniae* and the influence of temperature on the predator's activity.

MATERIALS AND METHODS

An experiment was conducted in October 1981 at Waite Agricultural Research Institute, Glen Osmond, South Australia using predators and aphids from their insectary cultures. It was conducted at constant temperatures of 15, 20 and 25°C under LD 12 : 12, and comprised four treatments of different numbers of *M. persicae* instars offered to each predator larva every day throughout the experiment (Table 1).

The predator larvae were used in the experiment within 24 hours of the eggs hatching, and the aphids were fed to them on potato leaf discs (3 cm in diameter) inside small cages as described by Hussein (1982). There were 4 larvae (replicates) at each treatment but because of limited resources the experiment was run as 2 blocks in time with 2 replicates in each block. On any one day, the aphids to be given in the different treatments were randomized amongst the predator larvae.

Table 1 shows that during its first larval instar, each predator was given 15 aphids each day; and in its second and third instar, each larva was given 35 aphids. The ratios of the numbers of different aphid instars given as prey were converted to percentages of the total prey presented. The proportion of any aphid instar eaten on one day was similarly estimated by totalling the numbers of that instar eaten by each of the 8 larvae in the 4 treatments at each temperature and dividing the total then by the total number of prey presented. The proportions were then expressed as percentages.

It should be noted that this experiment was designed to be analysed as Maelzer (1978) did by pooling the results of all treatments for each day rather than by treatments. The treatments were included to test preference over a range of probabilities of occurrence of different aphid instars (Maelzer, 1978). To detect any preference of larvae of different ages within a stadium and at different temperatures, the temperatures have been converted to day-degrees above 2.6°C (Maelzer, 1978) required for development so that the duration of development of larvae at each temperature have then been expressed in the appropriate interval of day-degrees with the predator's stadium *(Fig. 1)*.

The probability of capture was defined as the ratio between the percentage of each instar eaten divided by the percentage of total prey. The ratios have been found often to be of the same relative magnitude to each other as the

TABLE 1
The numbers of different instars of the aphid, *M. persicae,* that were offered to larval *M. tasmaniae* as different treatments

Treatment number	No. of aphids given to 1st instar larvae				No. of aphids given to 2nd & 3rd instar larvae		
	Instar I	Instar II	Instar III	Instar IV	Instar II	Instar III	Instar IV
1	10	5	—	—	15	5	15
2	10	—	5	—	15	15	5
3	10	—	—	5	20	10	5
4	5	5	5	—	20	5	10
Total	35	10	10	5	70	35	35

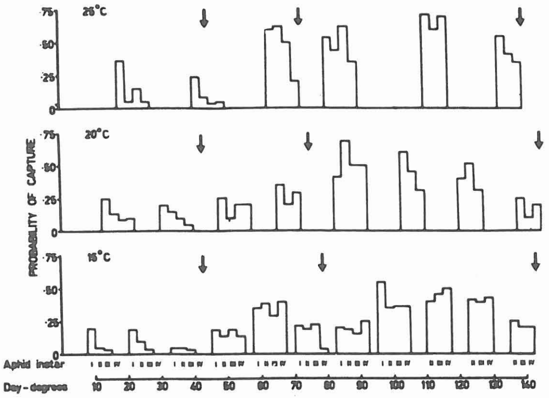

*Fig. 1. Probabilities of capturing different instars of **M. persicae** by larvae of **M. tasmaniae** at three different temperatures. Arrows indicate the end of the 3 larval stadia.*

probabilities of capture estimated by Chesson (1978) and Maelzer (1978). For larvae to show preference for certain prey instars, the percentages of prey eaten should be greater or less than the percentages of prey presented (Maelzer, 1978).

It is well known that the previous experience of a predator may affect hunger levels which in turn may cause significant relative changes in the probability of capture (Hassell, 1976). This may be true when experiments are conducted over a very short period, say a few hours or so, as did Dixon (1959) and Wratten (1973). However, in this study, estimates of relative probabilities of capture of *M. persicae* of different instars of *M. tasmaniae* were obtained over much longer periods than those used to estimate probabilities of capture by successful encounters (Dixon, 1959; Wratten, 1973; Chesson, 1974). The longer periods included periods of hunger and non-hunger, so the hunger level is not likely to have caused complications.

RESULTS

Probability of Capture of Prey

Figure 1 shows that at each temperature, the trend in the probability of capture of *M. persicae* by larvae of *M. tasmaniae* increased to a peak after each larval moult and declined just before moulting. Similar trends have been observed by Dixon (1959) and Wratten (1973) with a coccinellid predator *Adalia bipunctata*. In this study, the trend was most obvious at 15°C. The apparent decreases in the probability of capture (at the day-degrees indicated by the arrows in *Fig. 1*) correspond to the decreases in slope of the larval growth and voracity curve. Again, these decreases are most obvious at 15°C. The data also indicate that the efficiency of *M. tasmaniae* larvae in capturing *M. persicae* increases with age and with each moult. Similar results have been obtained for coccinellid predator on sycamore aphids (Dixon, 1959 and 1970), wheat aphid (Brown, 1972), lime aphids (Wratten, 1973) and rose aphid (Chesson, 1974; Maelzer, 1978), but the methods of estimating probability of capture were different. Dixon (1959 and 1970) also found that *A. bipunctata* and *A. decempunctata* captured more small aphids than large ones. However, in this study, except during the early stages of larval development, larvae of *M. tasmaniae* seemed to be able to capture efficiently both small and large *M. persiae*. The lower efficiency of *Adalia* larvae in capturing large prey was because of effective escape responses the prey possessed such as kicking away the larvae when encountered (Wratten, 1973).

The influence of temperature on the probability of capture by larval *M. tasmaniae* is shown also in *Figure 1*. The probability of capture of prey increases with temperature probably because of increased larval growth at higher temperatures. So too, the probability of first instar of the aphid *Macrosiphum rosae* being captured by second instar of the coccinellid species, *Leis conformis* increased markedly at 25°C (Chesson, 1974). The increased voracity with temperature recorded for coccinellid predators by Dunn (1952), Sundby (1966), Maelzer (1978) and others is probably due partly at least, to increased probability of capture resulting from greater mobility of predator larvae as temperature increases. With *Chrysopa carnea* (Neuroptera: chrysopidae) larvae, Sundby (1966) found 25% more aphids were consumed at 21°C than at 16°C.

Preference for Prey

Figure 2 illustrates the preference for each aphid instar as percentage differences from expected (solid black areas) in relation to the percentages of prey of each instar that were presented to the predators. Young predator larvae showed some preference for smaller prey as illustrated by positive percentage differences, whereas older larvae of *M. tasmaniae* exhibited no preference. Temperature seemed to have very little or no influence on prey preference. By contrast, studies on coccinellid predators have shown that larvae changed their preference for different aphid instars from day to day (Dixon, 1959; Wratten, 1973; Maelzer, 1978), the change being attributed to different probabilities of capture (Chesson, 1978).

Whether or not the predator has a preference for some particular aphid instar will have some influence on the change in size of prey populations within which the predator is presented with a choice between more than one age group of prey. A predator like *M. tasmaniae* which shows very little or no preference for prey size is more likely to be a better candidate for biological control of aphids.

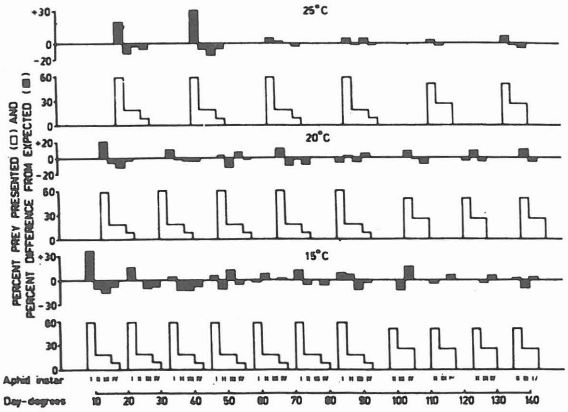

*Fig. 2. Percentages of different instars of **M. persicae** presented (☐) and of the difference from expected (■) (i.e. the difference between percent presented and eaten by larvae of **M. tasmaniae**) at three different temperatures.*

DISCUSSION

The abundance of *Hemerobius pacificus* (Neuroptera: Hemerobiidae) and *M. tasmaniae* was studied by Neuenschwander (1975) and Hussein (1982), respectively. Neuenschwander *et al.* (1975), found in Coastal California, USA, numbers of adult *H. pacificus* were higher in January – February while in the valley, adults responded to the late spring (May) peak of the aphids occurring in the alfalfa fields. The lower numbers of *H. pacificus* adults in the valley was attributed to heavy mortality suffered by the eggs, larvae, and pupae under high summer and early autumn temperatures occurring from July – September. Comparison between the phenologies of *H. pacificus* in the two areas suggest that the coastal areas constitute a stable zone of permanent occupancy (Huffaker and Messenger, 1964), where the adult predators show a high rate of aphid-density dependence. The abundance of *M. tasmaniae* and possibly other hemerobiids under cooler conditions in the field may be because they can be reproductively active at extremely low temperatures (– 4°C) that is sufficient for the normal development of their immatures (Neuenschwander, 1975; Syrett and Penman, 1981; Hussein, 1982).

Quite recently, hemerobiids have been shown to have good potential for biological control of aphids (Neuenschwander, 1975; Neuenschwander and Hagen, 1980; Hussein, 1982). With respect to the feeding habits, hemerobiids are among the least voracious when compared to coccinellids, syrphids and chrysopids (Neuenschwander *et al.*, 1975). However, *M. tasmaniae* has some advantages which are common to most hemerobiids over the other species of aphid predators. The larvae of *M. tasmaniae* have a higher probability of capturing prey and are most efficient at low prey density which is very useful in the control of aphids as a vector of virus diseases of crop plants.

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