A PRELIMINARY INVESTIGATION INTO THE LONGEVITY AND FECUNDITY OF *MICROCTONUS HYPERODAE*, A PARASITOID OF ARGENTINE STEM WEEVIL

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SUMMARY

Details of fecundity and longevity are necessary for life table construction and simulation modelling of the parasitoid *Microctonus hyperodae*. Under optimum conditions at 20°C the mean longevity of *M. hyperodae* was found to be 17.4 days amongst non-ovipositing parasitoids and 21 days amongst ovipositing parasitoids. Four parasitoids of Brazilian origin were found to lay a mean total of 31 eggs; 31% of these were laid in the first 24 hours and 46% after 72 hours. This behaviour was taken to result from pro-ovigenic reproductivity and under optimum conditions the species appeared to live much longer than necessary to lay its full complement of eggs. The adaptive implications of this are discussed.

Keywords: *Microctonus hyperodae*, fecundity, longevity, Argentine stem weevil, biological control

INTRODUCTION

The impact of Argentine stem weevil (ASW) (*Listronotus bonariensis*) (Kuschel) on pastoral agriculture is well known, at least within the scientific community. It has been estimated to cost the country's pastoral industry between NZ\$78-251M pa (eg. Prestidge *et al.* 1991). While it is recognised as the nation's worst pest of ryegrass, the species can also cause serious losses in cereal crops, particularly during establishment.

The discovery in the early 1980's that the impact of ASW can be off-set by grass resistance based on the endophyte *Acremonium lolii* Latch, Christensen & Samuels (eg. Prestidge and Ball 1993), has been particularly important in the development of management strategies for the pest. However, since then it has been increasingly recognised that endophyte can cause a range of significant stock health problems, apart from the well known condition of ryegrass staggers (eg. Fletcher 1993). It was in this context that the current effort to establish classical biological control of ASW commenced and between 1989-90 seven different 'ecotypes' of *M. hyperodae* were imported from diverse South American habitats (Goldson *et al.* 1990). In the winter of 1991, 100 000 *M. hyperodae*-infected weevils were released in the northern North Island, Canterbury and Otago/Southland. These populations consisted of equal numbers of each ecotype to ensure that the widest possible range of genetic material was able to establish at each site (Goldson *et al.* 1993). Since then, the species has established at 10 out of 12 sites (Goldson *et al.* 1994a) and now appears promising as an effective control agent against ASW (Goldson *et al.* 1994b).

Part of the current research programme into *M. hyperodae* is aimed at developing sufficient understanding of the parasitoid's impact to allow it to be integrated into other ASW management systems. Such an IPM approach demands detailed information on both the weevil's and parasitoid's population dynamics. This in turn calls for data on *M. hyperodae*'s fecundity and longevity. A preliminary study (Ellis unpublished data) examined these aspects using two of the ecotypes imported from South America (Goldson *et al.* 1990). However, there was higher than expected parasitoid mortality early in the experiment because of difficulty in controlling humidity.

This contribution presents results from a study aimed at assessing the parasitoid's reproductive potential.

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METHODS AND MATERIALS

Parasitoid longevity

During the maintenance of the *M. hyperodae* cultures, a random ecotypic selection 29 adult parasitoids <24 h old was transferred to 55 x 20 mm glass vials with one individual per vial. Each vial contained a 200 mm² section of paper towel and 16 mm² filter paper square soaked in honey water as a food source for the parasitoid. These individuals were held at 20°C under a 16:8 L:D photoperiod in a controlled environment cabinet. All of the vials were checked between 1000 - 1200 h daily and mortality recorded. The honey square was replaced as required. Since there were no weevils present there was no oviposition.

A selection of four individuals from Porto Alegre (Brazil), three from Bariloche (Argentina) and three from Colonia (Uruguay) were used to ascertain the longevity of ovipositing parasitoids. Individual parasitoids <24 h old and 16-20 unparasitised weevils were introduced into 70 x 120 mm diam. cages with gauze lids kept moist with a fine spray of water. As a food source for the weevils, each cage also had a single bouquet of annual ryegrass (*Lolium multiflorum*) cv. Tama with its roots wrapped in a polythene bag. Duration of exposure of each parasitoid to the weevils was for 24 h after which it was removed and placed in a vial containing a 16 mm² of filter paper soaked in a 50/50 honey/water solution as a food source. After 15-30 minutes the same parasitoid was then reintroduced into a new cage with a new population of 16-20 unparasitised weevils. This procedure was repeated until the parasitoid died and longevity thereby determined. This study was conducted at 19 ± 1°C and a 14:10 L:D photoperiod.

The ASW population used was collected by sweep netting at night, ryegrass (*L. perenne*) pasture on the AgResearch Lincoln Research Farm. The weevils were thereafter maintained at 10°C until required.

Parasitoid fecundity

Parasitoid fecundity was determined by totalling the eggs laid in the weevil populations exposed to each of the four individuals from Porto Alegre (BR1 - BR4). After their 24 h exposure to the parasitoid, each group of 16-20 weevils was held for a further 7 days at 19 ± 1°C to allow the parasitoid eggs to reach a size readily identifiable by dissection. The weevils were also checked every 48 h and cadavers removed and dissected to ascertain the presence of parasitoid eggs.

RESULTS AND DISCUSSION

Parasitoid longevity

The longevities of non-ovipositing and ovipositing parasitoids at 20°C was not significantly different at 17.4 ± 2.9 days (N = 29) and 21.0 ± 7.0 days (N = 10) respectively. Overall these results were comparable to the mean of c. 17.5 ± 2.2 days (N = 9) found in a separate study where non-ovipositing parasitoids were fed with 50% glucose solution (Hodgson *et al.* 1993). Although all of these assessments involved different handling configurations there is little reason to believe that these would have impacted differently on longevity. Longevity of parasitoids under field conditions is yet to be ascertained but will no doubt be temperature dependent.

Parasitoid fecundity

The mean fecundity of the four Porto Alegre parasitoids was 31 ± 27 eggs. Such variability resulted from one female laying 14 eggs over her 16-day lifespan (BR2) compared with 54 eggs over 19 days from another (BR1) (Fig. 1). However, the mean result is comparable to the average fecundity of 32.6 ± 8.8 recorded for an ecotype collected from General Roca (Argentina) (Ellis unpubl. data). This was despite a mean longevity of only c. 9 days resulting from problems associated with low humidity. The current results are in general agreement with other estimates made for *Microctonus* spp. Loan (1960) counted 56-80 ripe ova in the paired ovaries of *M. aethiopoides* Loan. This estimate of fecundity was later confirmed by Fusco and Hower (1974) who found that *M. aethiopoides* laid a mean of 59 eggs/female. Fusco and Hower (1974) reported that maximum fecundity of *M. aethiopoides* was achieved when individual females were placed with non-parasitised groups of *Hypera postica* (Gyllenhal) (Coleoptera:

Curculionidae) every 24 hours as compared with weevils supplied every 48 and 72 hours. Loan (1963) found that while *M. sitonae* Mason had a reproductive potential of 40-60 eggs, field data indicated that each female laid only about 6 eggs. Drea *et al.* (1972) noted that *M. stelleri* Loan was able to lay at least 150 eggs/female in *H. postica* larvae within the first 2 weeks after eclosion. Given the variation within these reports it would therefore seem that the reproductive potential of *Microctonus* spp. is comparatively diverse and is not necessarily realised under field conditions.

Figure 1: Cumulative egg deposition and longevity of four individual *Microctonus hyperodae* originating from Porto Alegre, Brazil (BR).

Temporal patterns of egg-laying

Peak ovipositional effort (31%) by *M. hyperodae* in this study was found to occur in the first 24 hours with 46% of total oviposition completed after 72 hours. In all cases, parasitoids survived well beyond the period after which oviposition had ceased, with two parasitoids surviving for a further 9 and 10 days respectively (Fig. 1). Although speculative these results suggest that Ellis' population may well have fulfilled its reproductive potential before desiccation-induced mortality (Ellis unpubl. data); hence the similarity of his results to those of this study.

The almost immediate onset of intense oviposition in the early part of the parasitoid's life span (Fig. 1) indicated that, consistent with dissection data (unpubl. data), *M. hyperodae* was pro-ovigenic in that the species eclosed with mature or nearly mature eggs. Such reproductivity is consistent with that found in several other *Microctonus* spp. (Loan and Holdaway 1961; Drea *et al.* 1972).

Related to pro-ovigenesis, this study showed that under optimum conditions *M. hyperodae* from Porto Alegre apparently exhausted their complement of eggs before age-related mortality occurred. By way of speculation, it may be argued that this is an adaptation by *M. hyperodae* to its primitive habitat. In its native South American habitat (Goldson *et al.* 1990), the observed longevity would presumably give the

parasitoid sufficient time to search for and parasitise ASW populations. However, these ASW would have certainly been more sparsely distributed than in the cages used in this study and it is therefore likely the whole life-span would be required for the parasitoids fecundity to be realised.

Finally the pro-ovigenic reproductive system of *M. hyperodae* raises the potential for histological examination of the parasitoid's ovarioles as a way of confirming fecundity by counting the eggs present (eg. Smith 1952). Similarly by counting the remaining eggs in field-collected parasitoids, it may be possible to interpret the extent of earlier oviposition of field-collected parasitoids.

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