THE EFFECT OF STORAGE ON THE ABILITY OF ARGENTINE STEM WEEVIL TO SUSTAIN DEVELOPMENT OF THE PARASITOID *MICROCTONUS HYPERODAE*

S.L. GOLDSOON and J.R. PROFFITT

MAF Technology, P.O. Box 24, Lincoln, Canterbury

SUMMARY

Storage of regularly fed *Listronotus bonariensis* for 8 weeks at 10°C and 14:10 L:D photoperiod did not adversely affect the species' suitability as a host of the parasitoid *Microctonus hyperodae*. This was in spite of a caging effect which is known to suppress the reproductivity of weevil populations. Such a result has important implications for research into the parasitoid since it permits the storage of large populations of weevils which are able to be collected when conditions are optimum. Additionally, it would seem that under caging conditions at least, *M. hyperodae* preferentially attacked *L. bonariensis* that had earlier been reproductive.

INTRODUCTION

The thelyketous braconid parasitoid *Microctonus hyperodae* has been identified as a potentially useful biological control agent active against the Argentine stem weevil, *Listronotus bonariensis* (Loan and Lloyd 1974). As part of a MAF/DSIR initiative the wasp has recently been imported into quarantine in New Zealand where amongst other things, it is being evaluated for its host specificity and general suitability for release (Goldson *et al* 1990). Quarantine procedures and the anticipated mass-rearing of parasitoid populations prior to release (should permission be granted) require that they be readily reared on *L. bonariensis*.

While populations of *L. bonariensis* can usually be readily swept from ryegrass pasture at night, they cannot always be reliably collected in high numbers. Collection of useful populations can be confounded by rain, dew, slugs or temperatures below c.10-12°C (Goldson unpublished). Consequently research into *M. hyperodae* would be greatly simplified if substantial numbers of *L. bonariensis* could be collected on ideally warm evenings and then stored before use. Unfortunately such storage of *L. bonariensis* has a suppressive effect on the species' reproductivity (Goldson 1981). It has been found that the proportion of field-collected weevils with eggs in their calyces dropped from 90% to 20% within 10 days of caging (Goldson 1979). This rapid change in reproductive status additionally led to the resorption of terminal oocytes, manifesting itself as β -carotene crystals in the ovariolar pedicels (Goldson 1983; Barker *et al* 1988). All of these changes have many features in common with those at the onset of diapause (Goldson 1983). Since Lloyd and Loan (1974) have reported that diapause precludes the development of *M. hyperodae* beyond the first instar, it is possible that caging may affect the ability of *M. hyperodae* to sustain the development of the parasitoid. Because the imperative has been to maintain as much genetic diversity as possible (Goldson *et al* 1990), the quarantined *M. hyperodae* population to date has been reared only on freshly collected *L. bonariensis*.

This contribution reports on an experiment to determine whether prolonged caging of *L. bonariensis* affects its suitability as a host of *M. hyperodae*.

METHODS

A 'stored' population of c. 5000 *L. bonariensis* was collected at night by sweeping from a paddock of *Lolium perenne* (cv. Nui) on 21 December 1989. This consisted of older overwintered mature weevils and a proportion of first summer generation

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immature weevils (Goldson 1981). After collection, until the experiment commenced on 15 February 1990, the weevils were maintained in two 200 mm diameter ventilated polycarbonate cages at 10 °C under a 16:8 L:D photoperiod. Fresh glasshouse-grown *L. multiflorum* plants with their roots wrapped in small polythene bags were replaced twice weekly as a food source. An 'unstored' population was collected in the same manner on 14 February 1990 from the same location. This consisted of a mixture of reproductive and non-reproductive first summer generation weevils (Goldson 1981).

Immediately prior to commencing the experiment subsamples of c.50 female weevils were randomly selected from both the stored and unstored populations for dissection. Their reproductive condition was ascertained in terms of the presence of eggs and/or resorption crystals. Only females were considered, as the reproductive condition of males varies less obviously (Goldson 1981). Similarly, after the experiment the remaining live weevils from both populations were examined for reproductive condition.

All phases of the experiment were conducted at c.18 °C and 80% RH, under a 14:10 L:D photoperiod. The stored and unstored treatments each consisted of six replicates of 40 weevils. The inoculation cages were transparent polycarbonate containers, 120 mm in diameter x 70 mm deep, with a 0.5 mm mesh floor for ventilation. A small amount of chopped *L. multiflorum* was provided as food for the weevils. Three adult *M. hyperodae* <14 days old were placed into each cage for 48 h. Thereafter each population of weevils was transferred to a holding cage consisting of an upper and lower chamber, each 100 mm in diameter x 60 mm deep. The upper chamber was fitted with a 0.5 mm gauze floor to allow emergent prepupae to drop and pupate under strips of paper towel in the lower chamber. The weevil populations were fed with fresh *L. multiflorum* changed every 3 days. Pupae were collected at the same time and stored in humidified petri dishes until eclosion.

Overall the experiment ran for c.7 weeks.

RESULTS AND DISCUSSION

Development of *M. hyperodae* in its host *L. bonariensis* was not adversely affected by the latter's prolonged storage prior to infection. The unstored population sustained 41.3% parasitoid development, compared with 62.5% in the stored population (Table 1). Percent pupal eclosion in both populations was consistently high at 88-89% (Table 1). The collection and storage of large populations of *L. bonariensis* with no deterioration in their ability to maintain development of *M. hyperodae* has therefore greatly simplified the rearing process.

TABLE 1: Effect of storage of Argentine stem weevil on the development of the parasitoid *Microctonus hyperodae*. Means of six replicates.

Weevil population	% parasitoid establishment	No. of parasitoid pupae	Number of adults	% survival
Stored	62.5	25.0	22.0	88.1
Unstored	41.3	16.5	14.7	88.8
LSD (1%)	11.2	4.5	4.8	15.8

There was a tendency for the proportion of reproductive or formerly reproductive weevils in a population to be reduced as a result of attack by *M. hyperodae*. Prior to the experiment, 24.1% of the stored and 19.6% of the unstored weevils were estimated to have been reproductive; these were found to have dropped to 16.0% and 7.3% respectively during the 5 week parasitoid development phase of the experiment (Table 2). Such a trend suggests that the parasitoid may have preferentially attacked reproductive or formerly reproductive hosts. This would seem to be selectively advantageous as *Microctonus* spp. usually develop in reproductively active hosts (Loan and Holdaway 1961; Loan and Lloyd 1974).

The significantly ($P < 0.01$) higher rate of parasitoid development in the stored population than the unstored was contrary to expectation. Goldson (1981) had earlier shown that storage imparts a suppressive effect on *L. bonariensis* reproductivity. Power

TABLE 2: Comparison of the reproductive status of stored and unstored Argentine stem weevil pre- and post-experiment as ascertained by dissection of live weevils.

Weevil population	Stored		Unstored	
	No dissected	% mature weevils	Number dissected	% mature weevils
Pre-experiment	58	24.1	46	19.6
Post-experiment (live weevils)	25	16.0	41	7.3
Sign. of diff (binomial distrib.)		n.s.		n.s.

and Singh (1974) have described this condition as 'ovarian diapause', a state that Loan and Lloyd (1974) noted precluded *M. hyperodae* development beyond the first instar in overwintering field populations. The unexpectedly high level of parasitoid development may have been related to underestimation of the stored population's original reproductivity at the time of its collection. Since the population had been in storage for 8 weeks, the estimate was by necessity based on resorption crystals (Table 2). While the presence of β -carotene crystals definitely indicates resorption of one-time well-developed terminal oocytes (Goldson 1983), their persistence under storage conditions is uncertain. The possibility of underestimation is further supported by data that show that on 21 December of 1976 and 1977 c.65% of the field population contained eggs compared to c. 35% in mid-February 1977 and 1978 (Goldson 1981).

An alternative or complementary explanation is that the initially immature weevils in the stored population were able to develop during the 8 week storage period. However, this is likely to have been very slow as the ambient temperature of 10°C is very close to the development temperature threshold (Goldson *et al* 1982; Barker 1988).

Essentially this study showed unequivocally that storage of *L. bonariensis* at 10°C under a 14:10 L:D photoperiod did not negatively affect the weevil's ability to sustain development of *M. hyperodae* even though they apparently showed reduced reproductivity. It would additionally seem that the parasitoid may preferentially attack mature weevils. A high proportion of sexually mature weevils at the time of collection may lead to a high yield of parasitoids. Further work is needed to confirm this.

REFERENCES

- Barker, G.M., 1988. Effect of temperature on development and survival of Argentine stem weevil *Listronotus bonariensis* immature stages. *N.Z. J. Zool.* 15: 387-390.
- Barker, G.M., Prestidge, R.A. and Pottinger, R.P., 1988. Reproductive phenology of *Listronotus bonariensis* (Kuschel) in northern New Zealand pastures. *Bull. ent. Res.* 78: 659-668.
- Goldson, S.L., 1979. The reproductive seasonality and morphology of Argentine stem weevil *Hyperodes bonariensis* Kuschel (Coleoptera:Curculionidae) and the effect of host grasses on its pre-reproductive development. Unpubl. PhD thesis, Lincoln College, University of Canterbury, New Zealand.
- Goldson, S.L., 1981. Reproductive diapause in the Argentine stem weevil *Listronotus bonariensis* (Kuschel) (Coleoptera:Curculionidae) in New Zealand. *Bull. ent. Res.* 71: 275-288.
- Goldson, S.L., 1983. Implications of oocyte resorption bodies in the ovarioles of Argentine stem weevil, *Listronotus bonariensis* (Coleoptera:Curculionidae). *N.Z. J. Zool.* 10: 111-116.
- Goldson, S.L., Penman, D.R. and Pottinger, R.P., 1982. Computer modelling of Argentine stem weevil (Coleoptera:Curculionidae) phenological events. *N.Z. Entom.* 7 (3): 236-238.
- Goldson, S.L., McNeill, M.R., Stufkens, M.W., Proffitt, J.R., Pottinger, R.P. and Farrell, J.A., 1990. Importation and quarantine of *Microctonus hyperodae*, a

- South American parasitoid of Argentine stem weevil. *Proc. 43rd N.Z. Weed and Pest Control Conf.*: In press.
- Loan, C.C. and Holdaway, F.G., 1961. *Microctonus aethiops* (Nees) auctt. and *Perilitus rutilus* (Nees) (Hymenoptera: Braconidae), European parasites of *Sitona* weevils (Coleoptera: Curculionidae). *Can. Ent.* 93: 1057-1079.
- Loan, C.C. and Lloyd, D.C., 1974. Description and field biology of *Microctonus hyperodae* Loan, n. sp. (Hymenoptera: Braconidae, Euphorinae) a parasite of *Hyperodes bonariensis* in South America (Coleoptera: Curculionidae). *Entomophaga* 19(1): 7-12.
- Power, R.J.B. and Singh, P., 1974. Laboratory rearing method for the stem weevil, *Hyperodes bonariensis* (Coleoptera: Curculionidae). *N.Z. J. Zool.* 1: 531-536.