Nymphal development and lifecycle length of *Kikihia ochrina* (Walker) (Homoptera: Cicadidae)

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The length of the lifecycle of cicadas depends largely on the duration of the subterranean nymphal stage, which can be determined by rearing. However, there have been relatively few attempts to rear cicada nymphs and consequently the length of lifecycle is known for less than 20 of the estimated 1200 species of cicada world-wide (Karban 1986, Moulds & Carver 1991). Of the 34 described species in New Zealand (Larivière 2002), the length of lifecycle is known for only one species: *Kikihia muta* Fabricius. Cumber (1952) studied *K. muta* on flax (*Phormium tenax*) and concluded that the lifecycle of this species was likely to be three years. This was based on the distribution of nymphal instars in soil, rearing experiments over the course of 12 – 17 months and an estimated egg development period of 12 months. I reared nymphs of the April green cicada, *Kikihia ochrina* (Walker), a common species in the North Island, as part of on-going studies of cicada ecology in kiwifruit orchards. *Kikihia ochrina* occurs in native and modified habitats (Fleming 1984) and commonly emerges from soil under mahoe (*Melicytus ramiflorus*) (Logan & Connolly 2005).

To rear *K. ochrina*, I pruned 17 mahoe twigs (3 – 5 mm diameter, 100 – 120 mm long) bearing cicada egg-nests from the HortResearch kiwifruit orchard of Te Puke, Bay of Plenty, during late November 2002. Each twig was enclosed in a glass vial (25 mm diameter and 150 mm long) and the vials were sealed with a small block of moist 'oasis'. Vials were left at ambient shade temperature and checked daily for newly hatched nymphs until mid-January 2003. Nymphs hatched from 2 – 25 December 2002 on 12 twigs. Approximately 40 parasitoid wasps (*Idiocentrus* sp., Mymaridae) emerged from two of 17 twigs during the same period. On the day of hatching, nymphs were introduced to the soil surface of potted mahoe (n = 9 pots), a pigeonwood (*Hedycarya arborea*), and a wineberry (*Aristotelia serrata*). Pots (5 L) were filled with Te Puke sandy-loam that had first been air-dried and sieved. At the time nymphs were introduced, pots held a young established plant approximately 500 mm tall. Soil from five pots with mahoe and the pigeonwood was checked for cicada nymphs in early December 2003. Nymphs were found in four pots with mahoe (Table 1). The remaining undisturbed plants were re-potted into soil-filled buckets (10 L), with drainage holes in the base, and enclosed in fine mesh cages in October 2004. Plants in cages were checked for final instar exuviae and adult cicadas once a week during October and November 2004 and then on week days from 1 December 2004 until 31 March 2005. Adults of *K. ochrina* emerged from soil in three of five caged plants (Table 1). One adult emerged in December 2004, four adults in January 2005 and nine adults in February 2005. Soil in all pots was

checked for remaining nymphs in May 2005, but none were found.

Survival of *K. ochrina* was approximately 10 % after one year in pots and 7.5 % to the adult stage after two years (Table 1). The mortality rate of cicada nymphs is thought to be highest at establishment. Ito & Nagamine (1981) and Karban (1984) estimated a mortality rate of at least 95 % for young nymphs of *Mogannia minuta* Matsumura and *Magicicada septendecim* (Linnaeus) in the field, respectively. My results are consistent with a pattern of high mortality at establishment and relatively low mortality after establishment.

Based on adult phenology, eggs of *K. ochrina* are likely to be laid from January to May, with a possible peak in March (Logan & Connolly 2005). In this experiment, eggs of *K. ochrina* on mahoe twigs hatched in December. Eggs probably overwinter and hatch in the following summer, giving a 7 – 11 month period of egg development. This is consistent with the egg development time for other New Zealand species, *K. muta*, *Amphipsalta zelandica* (Boisduval) and *A. cingulata* (Fabricius), in which eggs are laid in summer and first begin hatching in the following July and August (Cumber 1952, Harford 1958, Logan *unpubl*.). With an egg development time of 7 – 11 months and a nymphal period of two years, *K. ochrina* has a lifecycle of three years.

Table 1. Survival and duration of the nymphal period of *K. ochrina* reared on potted native plant hosts.

Pot #	Plant host	Nymphs after 12 months (% survival)	Adults after 24-26 months (% survival)	Mean days from egg hatch to adult emergence (± s[1])
1	*M. ramiflorus*	3/23 (13.0)	- -	
2	*M. ramiflorus*	1/11 (9.1)	- -	
3	*M. ramiflorus*	1/21 (4.8)	- -	
4	*M. ramiflorus*	10/30 (33.3)	- -	
5	*M. ramiflorus*	0/16 (0.0)	- -	
6	*M. ramiflorus*	-	3/24 (12.5)	770 ± 34
7	*M. ramiflorus*	-	6/30 (20.0)	785 ± 7
8	*M. ramiflorus*	-	5/73 (6.8)	778 ± 15
9	*M. ramiflorus*	-	0/30 (0.0)	-
10	*H. arborea*	0/50 (0.0)	-	-
11	*A. serrata*	-	0/30 (0.0)	-

[1] s, sample standard deviation.

Adults of *K. ochrina* are not periodical, but have occurred during each of the five summers from 2001-02 to 2005-06 at the HortResearch kiwifruit orchard. It is possible that some *K. ochrina* complete their lifecycle in more than (or less than) three years. Variation in the length of lifecycle is known for other cicada species and may be related to host plant and food quality (Betbeder 1971, Ito & Nagamine 1981, Ellingson *et al*. 2002). Further rearing of *K. ochrina* on a range of host plants and under different conditions may provide evidence of a variable lifecycle length. The simple and relatively successful method of rearing reported here may also be useful to study the nymphal ecology and lifecycle length of other New Zealand cicadas.

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